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"To encourage in any practicable ways research work on chemical processes and materials of importance to the Textile Industry.

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AMERICAN
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VOLUME XXV MAY 4, 1936 NUMBER 9

Notes on

Cotton-Warp Sizing

By RALPH HART*

FOR a number of years the writer has kept a file on the subject of sizing of cotton warps, including laboratory and mill experimental notes, reports of weavers' meetings, trade literature, and clippings of abstracts and articles taken from various trade and scientific journals. The growing interest recently in a fundamental study of the sizing process has made it advisable to arrange this material and submit it for publication. Only such information has been included which is of special interest, or offers a new or fresh point of view on the various phases of the subject.

It is to be noted that the amount of space devoted to any one phase of the subject does not necessarily indicate its relative importance to the process; it denotes rather the amount of new or interesting material available. Furthermore, since conditions in different mills vary considerably and as the practice of sizing is not yet on a thoroughly scientific basis, there are many controversial points on the process; hence, some of the statements included are actually or apparently contradictory. However, sufficient information is given to enable one to judge the merits of the various claims. General acknowledgment is hereby made to all sources that have been consulted in preparing this paper, as individual acknowledgments were found not to be feasible because many of the references are anonymous or have not been retained. Wherever possible the matter is given in the words of the original writer, although the present writer has taken considerable liberty in arranging and modifying the material.

IMPORTANCE, FUNCTION, AND PURPOSE OF SIZING

Importance.—The process of sizing or slashing of warps is one of the most important in a cotton mill and should be in charge of thoroughly competent men. The opportunity here for loss of profits is enormous. The importance of the process is easily estimated when it is considered that one slasher may supply warps for 300 to 500 looms. One hour of careless work in slashing may cause weeks of bad work, loss of production, increase in seconds, and disorganization of labor arrangement with consequent dissatisfaction in the weave room.

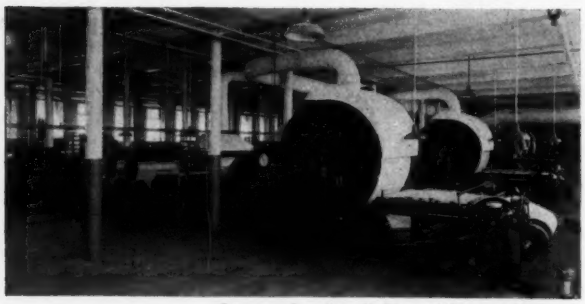
Function.—The primary function of sizing of cotton warps is to make the strength of the individual cotton fibers as effective as possible by cementing them together and secondary, to protect them against being rubbed up again during weaving. Unsized yarns under tension break partly by actual breakage of the fibers and partly by their slipping apart. In the sized yarn the fiber-cling or resistance to slip is greatly increased as a result of the cementing effect of the size. The strength of the sized yarn is still further enhanced by the surrounding film of size and the larger number of effective fibers, which offer greater resistance to breakage. The sized yarn acts more as if it were a single large solid fiber. Although the strength of a thin layer or film of starch is only a tenth that of cotton, its effect on the strength of the yarn is much greater than its intrinsic strength might indicate due, as already mentioned, to the decrease in slippage and increase in effective fibers. Sized yarns are not only stronger but offer also greater resistance to rubbing, though there is a decrease in extension.

Purpose.—The ultimate purpose of sizing is to enable the process of weaving to be performed smoothly and uninterruptedly, without injuring the yarns or affecting adversely the subsequent processes of finishing. Specifically the effects of sizing are (a) to give to the yarn the necessary stiffness, strength, and elasticity in order to enable it to withstand the mechanical operations of weaving, and (b) to give the yarn compactness and smoothness in order to reduce frictional resistance during the mechanical operations of warping and weaving.

While in the loom, the warp has to withstand many mechanical influences, some of which act on the yarn internally and some on the surface. Those influences which act internally are (a) the tension given to the yarn in the loom, and (b) the motion of the reeds, which alternately slackens and strains the warp at regular intervals in driving the filling into the warp. The influences which act on the surface are (1) the eyes of the heddles through which the yarn passes, (2) the reed which moves forward and back along the yarn, and so rubs the surface, (3) the rubbing of the yarns one against another, and (4) the shuttle which rubs against that part of the warp over which it passes. Apart, therefore, from the normal strains

*The Hart Products Corp.

imposed on the yarn, there are induced irregular tension-effects as well as a rubbing action; hence, the yarn must possess besides strength also elasticity and as smooth a surface as possible.



Courtesy Saco-Lowell Shops (March 1935 issue).

Fig. 1—Cotton Slasher

STARCHES AND GUMS

The qualities that give starch its usefulness as a sizing agent are (a) its ability to form a smooth film, (b) its adhesiveness, and (c) the high viscosity or thickness of its paste. A smooth non-scaly film tends to reduce rubbing friction; the adhesive properties of starch imparts strength to the sized warp by cementing the fibers together; and the heavy or viscous body of the starch-paste enables the yarn to take up more size than it would from more fluid solutions. Thick- and thin-boiling corn starches are mostly used in this country, followed in decreasing order by potato, sago and tapioca starches. Other agglutinants that are occasionally used, particularly for special effects are dextrins, locust bean gum, gum Karaya, and gum tragacanth. Attempts have been made recently to introduce sweet potato starch in sizing with indefinite practical results so far. It is stated that certain synthetic polymers (polyvinylalcohols), whose pastes yield uniform viscosities even upon prolonged boiling or violent agitation, have been recommended as suitable agglutinants for cotton warp sizing. These products are said to possess similar viscosity-characteristics as thoroughly cooked thick-boiling corn starch.

Corn Starch.—Corn starch granule is considered as a more or less homogeneous mixture of amylopectin (alpha-amylose), which is insoluble and very resistant to hydration, and a soluble adhesive material, known as amylose, with the preponderance of amylopectin on the outside of the granule but also with some distribution of it throughout. The ratio of amylose to amylopectin in corn starch is approximately 2 to 1. Corn starch granules have been measured from 14 to 26 or 28 microns with a number of granules much smaller and a few larger. It is stated that corn starch has a tendency to mildew and to give a harsh stiff feel to the yarn.

Potato Starch.—The granules of potato starch or farina are the largest of any of the starches known, with the exception of canna starch, and vary in size from 15 to 100 microns, depending upon their maturity. Potato starch forms semi-transparent pastes when boiled with water. It produces a smooth pliable yarn but has a tendency to give "soft" beams due to loss of strength. It is stated that ¼ per cent to ½ per cent of caustic soda added to the weight of the starch will reduce this tendency to "softening".

Sago Flour.—Sago starch or flour gives a paste having a comparatively low viscosity, with little tendency to drop on prolonged boiling. It is necessary, however, to boil sago for several hours in order to impart to the sized yarn the proper softness and pliability. The granules of sago starch measure on an average 10 to 60 microns.

One mill uses sago starch on print cloths and finds that it gives smooth and well running warps. It is cooked for 1 hour and 45 minutes. Another mill uses this starch on 64 x 60 construction, 2484 ends, 30s yarn, which was slashed with a sizing-mixture of approximately 1 pound of sago starch to 1 gallon of finished size, to which were added the necessary softeners.

Tapioca.—Tapioca or cassava starch produces a very thin paste on boiling and, like potato starch, loses strength with prolonged heating. It finds a greater application in finishing than in sizing. It is stated that tapioca gives a soft mellow feel to the yarn. One mill reports that it has used tapioca exclusively for sizing with fair success. It is stated, however, that tapioca is not so uniform in quality from lot to lot as corn starch. At this particular mill, tapioca is cooked the same length of time and at the same temperature as corn starch.

Sweet Potato Starch.—The National Bureau of Standards has found that sweet potato starch can be used satisfactorily for the sizing of cotton warps. Several cuts of 13½s and 32s cotton warps were sized with this starch under mill operating conditions. No difficulties were encountered in the weaving operation and the finished cloth appeared equal to similarly processed cloth which had been sized with high-grade Irish potato starch. It is concluded that sweet potato starch is a decidedly promising material for use as a warp-sizing agent, particularly as a partial substitute for tapioca.

Thin-Boiling Starch.—Thin-boiling starches have proven advantageous over thick-boiling starches in shorter cooking time, added smoothness, and better penetration. Comparative tests on yarns sized with thin- and thick-boiling starches seem to show that thin-boiling starch gives a greater increase in strength and also in weight than thick-boiling starch. This is explained by the fact that the thin-boiling starch penetrates the yarn better and is inside as well as on the outside of the yarn, whereas the thick-boiling starch covers only the outside. Another reason is that pastes of greater concentrations, without increasing the viscosity beyond a working limit, can be prepared with the thin-boiling starch. On an equal weight basis, however, the film-strength, adhesiveness, and weight take-up of thin-boiling starch are probably inferior to the unprocessed starch. For tightly twisted warps a thin-boil-

ing starch is superior to a thick-boiling one on account of its higher fluidity and consequently better penetrating qualities. One weaver reports that with thin-boiling starch, the average increase in tensile strength of a certain yarn was 19.8 per cent, which was 2 per cent greater than that obtained with thick-boiling starch; there was also a 3 per cent greater increase in weight (i.e., 16 per cent instead of 13 per cent) and half as many breaks on the looms.

Mill-Modified Starch.—Mills converting pearl starch with enzymes claim the following advantages over thick-boiling starch; increased weight of the warp yarn to the extent in some cases of changing the warp number as much as one number lighter, less shedding, weave-room sweeps materially reduced, no clogging of circulating-system pipes, freedom from lumps, absence of raw starch, cleaner cylinders, and greater ease of conditioning the warps for best weaving, as the converted starch seems to be more water-absorbent. On the other hand, there might be some difficulty in obtaining uniform fluidity and the expense of conversion is also to be considered.

One mill reports converting thick-boiling corn starch with aluminum sulfate. In this case 240 pounds of thin-boiling starch were replaced by 200 pounds of pearl starch boiled with ½ pound of aluminum sulfate. It is stated that the sodium salt of toluol sulfonchloramide is especially suited to the making of superior starch sizes. It is claimed that this chemical converts starches only to the soluble starch derivative, preserving the adhesive power of the original starch. For the usual run of cotton yarn, 1 pound of the agent is recommended for 100 pounds of starch in 125 gallons of water. The use of 1 pound of 28 per cent acetic acid to 100 pounds of starch has also been recommended for modifying thick-boiling corn starch.

Dextrines.—Dextrines in themselves have little value as size since it takes much more weight when compared with starch to impart equal strength to yarn; this extra weight tends to reduce the elasticity of the yarn still further. However, the strong adhesive power of dextrine makes it a useful adjunct to size to correct the loss of adhesiveness of the starch due to the presence of fat or oil.

Locust Bean Gum.—On boiling with water, locust bean or kernel gum gives a viscous neutral solution which may be used in sizing in combination with starch. Weak organic acids have little or no effect on the solution but mineral acids lower the viscosity. Alkalies gelatinize the endosperm gel to a transparent mass. Salts which have no alkaline reaction mix well with it. Salts which tend to dissociate on dilution in excess cause flocculation. One part of this gum is said to be equivalent to seven parts of starch. It is also stated that this gum gives a smooth, transparent, tough, and non-scaly film of exceptionally good binding power and with little tendency to chafe or mildew. The amount usually used in sizing is between ¼ per cent to ¾ per cent on the weight of the starch.

STARCH PASTES

Nature of Starch Paste.—Most investigators now believe that as starch granules are heated in water to form a paste they swell but do not ordinarily disintegrate or become disrupted. Starch pastes immediately upon gelatinizing are not true colloidal solutions but are suspensions of swollen granules. Potato starch presents an exceptional behavior in that the granules when heated in water not only swell but readily fragmentize and disintegrate.

Starch pastes, unless they have been severely boiled or otherwise treated to disintegrate the suspended particles, have the appearance of clear swollen granules, filled with a colloidal solution of starch. The intact starch granule does not swell much in the cold because its rigidity restrains it. Upon heating with water, there is a marked swelling of the starch granule due to the absorption of water. The main effect of heat is to make the structure of the granular less rigid and more distensible, and to accelerate the swelling. The granules have a balloon-like appearance and the diameter increases to somewhere between 50 to 100 microns (uncooked granule from 12 to 18 microns). A few of the granules, due to some weakness in their structure, will burst and present an opening on their sides from which, due to internal pressure, the amylose in colloidal solution is erupted. The majority of the granules, however, will remain intact. The viscosity of the paste is caused by each of the large swollen granules having a large amount of its surface in contact with its neighbors. What we have is a number of balloon-like granules all touching each other which, because of their large diameters, have necessarily large open spaces between them—these spaces being filled with water or colloidally-dispersed starch solution.

Upon long continued boiling and agitation of potato starch-paste, the envelope around the granule breaks down completely and seems to dissolve in the solution, whereas with thick-boiling corn starch the envelope breaks open but remains in the liquid as a shell. The viscosity of the boiled starch-paste is controlled to a great extent by the size of these broken-down amylopectin shells. Thin-boiling corn starches behave in this respect like potato starch.

Gelatinization and Viscosity.—A mixture of starch and water upon heating sets to an apparent gel, the viscosity of which increases with temperature to a maximum and then decreases upon continued boiling. It is stated that the larger starch granules begin swelling at a lower temperature than the smaller ones and that the swelling of the smaller granules is a slower process. It has been definitely shown that for a given starch there is no well-defined pasting temperature but rather a temperature zone of paste formation. The viscosity of a starch paste is akin to that of a suspension rather than that of a colloidal solution like a gelatin solution. The drop in viscosity on continued heating or stirring is attributed to the breakdown of the swollen granules and the disintegration of the sacs. It is stated that, in general, the viscosity of a starch-paste for satisfactory sizing purposes should be thin enough to give satisfactory penetration and thick enough to take up the proper amount of size.

Corn Starch Paste.—The viscosity of corn starch-paste decreases only slightly from its maximum upon continued boiling and agitation. One researcher reports that corn starch-paste begins to gelatinize at 83° C. and that there is a gradual increase in viscosity with temperature. On continued heating at 99° C, the paste under the conditions of the tests reached its maximum viscosity of 76 units (initial viscosity 37 units) in 30 minutes and dropped to a viscosity of 69 units after 2 hours of heating. Heating for 4 hours longer caused a further drop of only 2 units. It was also found that the viscosity of corn starch-paste is not greatly affected by moderate agitation. Thus, the viscosity after heating and agitating for 1 hour was 73 units and after 4 hours 71 units.

Potato Starch Paste.—A similar series of experiments with potato starch gave a gelatinization temperature of 61° C. and, as with corn starch, the viscosity continued to increase temporarily with the temperature. On continued heating at 99° C, it reached its maximum viscosity of nearly 13,000 units in 20 minutes (initial viscosity 37 units). The viscosity of the potato starch-paste decreased rapidly when the paste was heated and agitated. After 2 hours, under the conditions of the experiment, the viscosity became fairly constant (at only about 1 per cent of its maximum) and was not much greater than that of corn or sweet potato starch-pastes. A series of laboratory experiments has shown that the viscosity of potato starch size in the sow-box is very much less than its viscosity in the size kettle, due no doubt to the agitation it receives while being pumped from the cooking or storage kettles. The effect of stirring on the viscosity of potato starch-paste seems to be even greater than that of temperature. It is reported that the viscosity of a potato starch-paste of a certain concentration was reduced from 250 to 50 by only one minute of shaking at 16° C, and to 20 by the same shaking at 90° C.

Sweet Potato Starch Paste.—This starch was found to gelatinize at a temperature of 67° C. and to reach its maximum viscosity of 188 units in 30 minutes (initial viscosity 37 units). On continued heating at 99° C, the viscosity dropped to 149 units after 2 hours, and to 91 units after 6 hours. Like corn starch-paste, the viscosity of sweet potato starch-paste is not greatly affected by moderate agitation. It is claimed that sweet potato starch possesses satisfactory coating and penetrating qualities and should be well adapted for use in textile sizing. Its viscosity which lies between that of corn starch and white potato starch-pastes that have been treated and stirred for some time, shows relatively little change on heating for long periods of time.

Modified Corn Starch Paste.—The modification or conversion of thick- into thin-boiling starch renders a certain portion of the starch granule soluble in water. A paste of thin-boiling starch consists of ultramicroscopic particles intimately dispersed in the liquid medium, which also contains the soluble matter formed from the conversion. One reason modified starches have lower viscosities than thick-boiling starches is due to the presence of greater amount of soluble materials which do not add to the viscosity. Another reason is that instead of swelling, as thick-boiling starch does, the granules crack and break up into small fragments, due to the weakening of the amylopectin shells. They apparently flake off in layers similar to taking off the layers of skin on an onion and, if the heating and agitation is continued, these flake-like particles in turn break up into smaller fragments. Thin-boiling starches should be boiled for at least 30 minutes in order to break them down properly. It is stated that temperature and stirring have practically no effect on the viscosity of certain modified corn starch-pastes.

Effect of Acid and Alkali.—The addition of acids to starch-pastes in concentrations as low as 0.0025N causes a pronounced decrease in viscosity. The addition of alkalies causes a rise in viscosity followed by a decrease. A solution of sodium hydroxide is essentially a starch-gelatinizing agent inducing swelling of the granules at temperatures below the normal gelatinization range in water alone; this effect being proportional (within limits) to the concentration of alkali. The cells of a paste containing sodium hydroxide are more susceptible to rupture—i.e., more fragil—accounting for the lower consistency and different physical character of such a paste.

Effect of Calcium Chloride.—Extremely thick and adhesive solutions are formed when a concentrated solution of calcium chloride is boiled for three or four hours with starch, converting it into a soluble form. The effect of calcium chloride on starch-paste is so great that no syneresis (sweating of water from the gel) occurred after 60 days, if it was present in as little as 0.5M concentration. It is believed that this salt causes the formation of a firmer gel structure.

Penetrating and Coating Properties.—Penetrating and coating properties of starch-pastes depend on the viscosity and temperature of the pastes, and upon the pressure exerted on the sized yarn by the squeeze rolls. The viscosity of the starch-paste is determined in a general way by the size of the swollen starch-granules. Starch-pastes with small granules give good penetration; on the other hand, those with large granules possess good coating properties. The penetrating power of starches seems to follow the order of rice, wheat, corn, and potato, with potato starch showing the least penetration. Potato starch also does not seem to adhere well to cotton yarn and scarcely coats at all, probably due to the fact that the swollen granules are very large. They are too large to penetrate and they slough or dust off instead of adhering to the yarn. These results were obtained with 3.7 per cent starch-pastes boiled for 1 hour at 100° C. It is probable that, upon continued boiling and agitation until the potato starch granules are thoroughly disintegrated, the results may be more favorable.

STARCH FILMS

Tensile Strength and Flexibility.—Starch films have

tensile properties similar to those of ductile metals and there is apparently little difference in this respect between one starch and another. Experiments have been made on the tensile strength of films made by drying starch-pastes such as are commonly used in sizing. The results show that starch films are more brittle in dry atmospheres than in moist. Weaker films are obtained if the starch has been partly dextrinized, oxydized with hypochlorites, or otherwise more or less solubilized; furthermore, any admixtures such as soap, glycerine, oils, or fats tend to weaken the starch-film although such admixtures may be desirable on other grounds. Moreover, drastic chemical treatment or the use of alkali, soap, or excess of hard fat renders starch more brittle.

Moisture Properties.—The various starches are all about equal in moisture absorbing capacity. Starch alone boiled and dried absorbs about twice as much regain-moisture as raw cotton and is, therefore, no mean weighting or deliquescent agent. Starch films at a relative humidity of 80 per cent or over become soft and plastic, yielding readily to any stress, although the strength of the cotton yarn itself is improved. Hence, exposure of sized yarn to high humidities or the use of highly deliquescent size is not desirable.

SOFTENERS

Amount and Kind.—There seems to be no hard-and-fast rule regarding the amount of softener to be used in warp sizing; therefore each mill uses what it deems best. The British Cotton Research Association found that up to 5 per cent of softener on the weight of the starch did not appreciably reduce the adhesiveness of the starch, but beyond that figure there was a gradual reduction in the strength of the starch film. It is believed, however, that in batches where 1 pound or more of starch is used to 1 gallon of size, the softener can be increased above 5 per cent without appreciably decreasing the strength of the starch film.

The acidity of the softeners should be low, as otherwise the squeeze-rolls of the slasher may be affected. Emulsified softeners are preferred over raw oils and fats since they mix more uniformly, allow better penetration of the size, and form smaller globules of fatty matter. It is stated that excess fat may have a tendency to interfere with the proper penetration of the size and also to reduce the transparency of the starch-paste. On the other hand, it is to be noted that softeners tend to increase the resistance to rubbing. It is also claimed that the fatty ingredients in a sizing compound have a tendency to reduce the rate of congealing of the starch with the result that the size will remain fluid while passing through the squeeze rolls and until its water content is evaporated on the slasher drum or cylinder.

Effect on Flexibility.—It is stated that brittle films are produced when an excess of a hard fat such as tallow is introduced, the deterioration in flexibility becoming marked when more than about 5 per cent of fat is present. These observations suggest that excess of fat may give rise to the dusting of size which is troublesome in some mills, and this is borne out by observations in the laboratory.

METALLIC SALTS AND GLYCERINE

Metallic Chlorides.—The deliquescent chlorides of calcium and magnesium find a wide application in the cotton industry as components of sizing and finishing mixtures. Their value lies in their ability to be applied as weighting materials which remain liquid under normal conditions of use and storage of cloth. It is also stated that the metallic chlorides exert favorable mechanical effects during weaving, which however have so far not been adequately explained. Though these chlorides are technically unobjectionable in goods which are not subjected to heat in the grey state, they may cause tendering if they are present in cloth which is singed, or finished by a hot process. One mill-man states that metallic chlorides are frequently incorporated in warp-size mixes to add weight and pliability to the yarn, and however desirable to the weaver, they are detrimental to the finisher. It seems that most bleachers are troubled enough in kier boiling with water containing natural hardness, without having to contend with cloth saturated with additional amounts of these chemicals.

Tendering Effect by Salts.—Certain metallic chlorides or sulfates used in sizing when exposed to high temperature may decompose, liberating hydrochloric or sulfuric acid. The injurious effect of hydrochloric acid on cotton is well known; it reacts by hydrolysis with the cotton cellulose, resulting in a loss of strength and ultimate disintegration of the fiber. It is reported that the safe limit of free hydrochloric acid in cotton cloth subjected to drying would appear to be 0.01 per cent. This conclusion was based on a series of experiments wherein the cotton cloth was soaked in hydrochloric acid solutions of various dilutions, the samples dried without washing out the acid, and finally heated at a temperature of 120° C. The copper equivalent was then determined and so the corresponding amount of oxycellulose estimated, which in turn is approximately proportional to the loss in tensile strength of the cotton. In a similar series, using 0.05 per cent and 0.005 per cent of sulfuric acid and drying the yarn for 20 minutes at 100° C., the tensile strength dropped from 39.4 for the untreated cloth to 2.2 and 21.25, respectively.

Upon treating cotton with various salts at 208° F. for one hour, it was found that magnesium sulfate did not do much damage, calcium chloride did much more, and magnesium chloride still more, while no serious injury was observed in the case of sodium sulfate and chloride. The injurious action increased by 100 per cent on raising the temperature from 208° F. to 230° F. When the salts are more highly concentrated, injury to the fiber may be caused mechanically, for example, by the formation of crusts. In another series of experiments samples of cotton cloth were soaked in a 25 per cent solution of magnesium sulfate, heated at 190° C. for 15 minutes, and then washed

and conditioned. It was found that the samples lost in tensile strength to the extent of over 60 per cent.

Stability of Calcium and Magnesium Chlorides.—Calcium chloride heated for an hour at 180° C. to 200° C. was found to decompose only to the extent of 0.09 per cent and when heated to its melting point (about 800° C.), the decomposition was only 0.6 per cent. On the other hand, magnesium chloride decomposed 1-3 upon being heated to 250° C, and ½ when heated at 350° to 550° C. It is also reported that calcium chloride heated for 5 hours at 150° C, or for 2 hours at 165° C, showed no decomposition whatever, whereas magnesium chloride decomposed to the extent of 40 per cent. The same authority concludes that these experiments would appear to establish the fact that at any temperature which can possibly prevail in the manufacture or use of goods containing calcium chloride, this salt is perfectly stable and no fear of deleterious action need be entertained, whereas the reverse is the case with magnesium chloride. In this connection it is interesting to note that cotton cellulose begins to dehydrate at a temperature of 160° C, the fiber begins to turn yellow at 180° C, and at 250° C. the fiber starts to turn brown and destructive distillation begins.

Metallic Chlorides in Piece Goods.—One mill-man reports that it is not a safe practice to use metallic chlorides in sizing of cotton yarns to be used in cotton piece goods. Due to decomposition of calcium chloride in mill operations, particularly singeing, he claims that tendering takes place even before mill operations are started, or in other words, on prolonged storing. Also the presence of metallic chlorides in the sizing used on cotton fabrics usually results in considerable difficulty in dyeing and finishing, due to the fact that the metallic salts had been carried through the preliminary operations in sufficient quantities to cause the formation of lime-soaps, and, consequently, resist-effects on dyeing. Where the presence of metallic chlorides in sizing is known before the goods are processed it necessitates extra operations, and also the use of the more expensive muriatic acid to satisfactorily remove the metallic chlorides from the fabric before the cloth is in the condition where dyeing can be undertaken. He also claims to have found as much as 4 per cent and over of calcium chloride on the weight of the cloth.

Deliquescent Effect.—It has been found that both calcium chloride and magnesium chloride show inhibiting effects on the absorption of moisture when tested in combination with starch or on sized yarn. That is, sized yarn actually absorbs less moisture when the so-called deliquescent salts, including glycerine, are present. Such additions to size do not, therefore, take the place of adequate atmospheric humidity. The following table shows the moisture regains of sized yarn with and without the addition of deliquescent salts or glycerine.

	Moisture Regain of Sized Yarn		
Relative Humidity—per cent	40	60	80
	%	%	%
Sized yarn (with starch only)	5.8	8.0	10.9
Sized yarn and 0.35% glycerine.....	5.7	7.9	11.5
Sized yarn and 0.75% magnesium chloride	5.1	7.3	10.9
Sized yarn and 0.68% calcium chloride..	5.3	7.4	10.4

These results are held to indicate that the addition of a deliquescent salt or glycerine to size does not necessarily increase the percentage of water taken up by sized yarn.

MILDEW

Fungi and Bacteria.—The results of fungus growth on cotton are musty smell, colored stains, development of acid-products, and tendency for cellulose digestion. The destructive agents of cellulose fibers are; algae which require a continuous supply of water, mucous which require moisture and darkness, and fungi the most destructive class, the spores of which are universally distributed. Bacteria (a vegetable micro-organism of a lower order than the fungi or moulds) also have a deleterious effect on the cotton fiber. Only a limited number of the numerous kinds of fungi is capable of producing stains on cloth and a still smaller proportion, capable of causing tendering under ordinary conditions of exposure.

The effect of moulds and bacteria on cellulose is to transform it into glucose and ultimately into its oxidation products. The first step in the degradation of the cellulose is a hydration. Some of the end-products found are oxalic and citric acids, and protein degradation compounds. Attacked fibers are more soluble than normal fibers in carbon bisulfide-alkali mixture.

Effect of pH.—Mildew or fungi grow best below a pH of 5.0 and are retarded above a pH of 7.5. The latter on the other hand is favorable to bacteria, which is also favored by a low concentration of nitrogen salts.

Effect of Moisture.—It was ascertained that, in general, the development of mildew is governed by the degree of humidity of the surrounding air rather than by the actual moisture content of the textile material itself. Mildew develops in cotton goods only when these are present in the air of relative humidity of not less than 70 per cent to 75 per cent and when they contain more than 8 per cent to 9 per cent of moisture. According to the following table, mildew growth is not likely to occur in cotton containing 7 per cent of moisture or less:

Relative Humidity of Surrounding Atmosphere	*Moisture Content of Fabric*	*Nature of Mildew Growth*
%	%	
100	15.5	Profuse (after 14 days)
98	14.8	Profuse (after 14 days)
94	10.8	Profuse (6 weeks)
92	7.8	Moderate growth (9 weeks)
90	7.0	None (after 4 months)

Effect of Sizing Materials.—The goods that are most prone to mildew are those filled with starches, glue, casein, soaps, soluble oils, and glycerine. These agents furnish a readily available food-substance sufficient in amount to allow the development of moulds, thereby preserving the fibers from damage, but in other cases where the foodstuff is not present the fibers themselves are attacked and tendered. Rates of growth of mildew were noted on a number of sizing materials with the following results:

(Continued on Page 250)

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

MAY 4, 1936

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Standard Wash Fastness Samples

Cotton, Wool, Silk

The standard samples which have been in preparation for some time by the Sub-Committees on Fastness to Washing of Dyed Cotton and Dyed wool are now ready for distribution, and the original standard silk sample cards have been revised to correspond with the new system of classification first introduced in the 1934 Year Book.

These standards have all been carefully dyed with the dyestuffs and according to the dyeing methods recommended in the 1934 Year Book and each set includes a dyeing representing each of the different classes of fastness.

With these sample dyeings for reference it will be possible to accurately grade the fastness to washing of any dyed cotton, wool, or silk fabrics, by comparing them with the standards after subjection to the standard washing tests as approved by the Association.

The A.A.T.C.C. is now prepared to furnish these three sets of washing standards for $1.00 per set which is to cover the cost of preparation.

All inquiries concerning these washing standards should be addressed to the Chairman of the Research Committee.

LOUIS A. OLNEY,
LOWELL TEXTILE INSTITUTE,
LOWELL, MASSACHUSETTS.

The Textile Industry*

By B. B. GOSSETT

I FEEL deeply complimented at this opportunity to address such a fine group of men. May I say at the outset that I am speaking only for myself as an individual and not for any group or groups in the great Industry with which I am connected.

The subject assigned me is, "The Textile Industry". This is a rather large order. Considering the vastness of the industry and its many complexities and ramifications, I scarcely know how to begin. Perhaps it might be in order for me to introduce my remarks by quoting from Mr. Ralph Borsodi's book, "The Crisis in Textiles". Mr. Borsodi points out that:

"The industry engaged in the production of *all textiles and their products,* is from the standpoint of numbers employed the largest in the United States. It exceeds by approximately 800,000 the numbers employed as wage earners in the iron and steel industry, by nearly a million those engaged in the food industry, by more than a million those in the group of industries manufacturing automobiles and all equipment for transportation by air, land and water. These are industries universally recognized as among the largest in the country and yet in their contributions to the total consumer-buying power of the country—in their contributions to its economic life and general prosperity—they rate as mere pygmies when compared to the textile industry".

But it is the cotton branch of the textile industry with which the South is chiefly concerned. For this reason, I shall confine my remarks largely to this branch of the industry and not to the textile industry as a whole.

The cotton textile industry is made up of about 1,000 competitive mills with a present capacity of slightly less than 30 million spindles. Of these, according to the latest available statistics, there are approximately 700 companies, none of which has more than 30,000 spindles or more than one-tenth of one percent of the spindles in the industry. Of the 300 larger units, no one unit has more than 3 per cent of the productive capacity of the industry. It can therefore be readily seen that no one mill or group of mills can dominate the field and that the industry is a highly competitive one.

For the last 15 years, the fundamental weakness of our industry—the weakness that prevented it from showing a profit even in the prosperous years prior to 1929—was a tremendous overcapacity. One-half of its present spindles, if run six days a week without limitation upon hours of operations, would be sufficient to supply a demand for cotton goods equal to that of 1929.

There are only about 23 million active spindles today. Of these active spindles, approximately three-fourths are located in the South. Inasmuch as there are about seven million spindles in place that are not active at this time, it is inevitable that as and when the spread between cost of production and selling price becomes sufficiently attractive, many of these spindles will resume operations. It is thus clear that the great problem in our industry is really one of control of overcapacity rather than control of production. In fact, the term overproduction so far as manufacturing activity is concerned, is largely an imaginary one *when considered from the long-time view point.* Manufacturers can not and do not *indefinitely* produce more than the market absorbs. If such were the case, their resources would soon be exhausted by being converted into huge and unsalable inventories of completed materials. *Excess capacity,* however, *and the resultant ever present threat of momentary overproduction,* is what brought about the ruinous losses for the cotton textile industry prior to the establishment of the Cotton Textile Code. There was a situation whereby, due to excess capacity, the industry might, and in fact actually did, whenever the market looked favorable, produce more goods than could be sold at anything other than distress prices. As such situations recurred, prices would fall to points where the losses were so great that many mills economized by shutting down until the accumulation of surplus goods had been absorbed and until prices had reached the point where it seemed that resumption of operations was warranted. This condition was persistent and resulted in peaks of temporary overactivity always followed by valleys of inactivity and unemployment.

A marked overcapacity in an industry is destructive of fair competition in that industry. Where the productive capacity of an industry is reasonably in balance with the consumptive demand, there exists conditions for normal and fair competition. Buyers are competing actively among themselves to obtain their requirements; sellers are competing actively among themselves to dispose of their products. It is essential to the protective functioning of the competitive system that there be both this active competition among buyers and active competition among sellers. The system breaks down when the reasonable balance of this duality of active competition is lost or destroyed. Such balance is destroyed when there is

*Presented at annual meeting, Piedmont Section, Nov. 9, 1935.

an overhanging overcapacity in an industry. In that situation, there is an acute pressure on each unit in an industry to seek as large a share as possible of the inadequate demand for consumption. The overhead *based on capacity runs on.* There is not enough business to keep all busy and the pressure to reduce overhead by volume drives the seller into panic selling, whereas the buyer, knowing the overcapacity and ever present threat of overproduction, holds off in the knowledge that his demands can be amply satisfied and on his own terms whenever he gets ready to buy.

The destructive results of such a situation are obvious. Even the wage earner is adversely affected because there is usually a steady pressure for lower wages in order to make it possible to name lower prices in the hope of attracting sufficient business to keep the plant in operation. Naturally, under such conditions, the working capital of the weaker mills is rapidly exhausted and many of them are forced into liquidation or bankruptcy. Unfortunately, in such situations, the factory and machines are not destroyed—they merely afford a temptation for others to buy them in at a lower figure and to increase the unfair and destructive competition by operating them at fixed charges that are far less than those which are properly attributable to the amount of capital originally involved. It is true, some cotton mill machinery is being scrapped year by year, but at such a slow rate in proportion to the tremendous excess capacity, that more than a decade will be required to adequately correct this situation.

Under such conditions, now that N. R. A. is a thing of the past, the question naturally arises, what can be done to control this overcapacity? Personally, my faith is still unshaken in the efficacy of self-regulation. I still believe in the soundness of the *basic principles* of N. R. A. I would like to see its *principles* revived on a basis of *voluntary self-government.* Such a plan can be developed by our trade associations and made effective by the Federal Trade Commission through the setting up of a Code of Fair Trade Practices. Perhaps I should say that unfair trade practices should be defined so as to make it possible to deal with the recalcitrant element in our industry. In other words, under such a plan, I am loath to believe that many people in our industry would violate practices defined as unfair by the Federal Trade Commission after acceptance by a majority of the industry, and with the certain knowledge that such violations would be given wide publicity.

A moment ago I referred to our industry's failure to show a profit even in the prosperous years prior to 1929. No anomaly of the many in our own country's unprecedented prosperity during that period stood out so boldly as the failure of textiles to rise to the general level of that stimulation attained by other major industries. The strange spectacle was witnessed of various other lines, some of them mere infants of industry, employing relatively few laborers and with limited capital investments, rushing to peak production, enjoying increased consumer-demands, making tremendous profits and paying proportionately good wages while textiles, among the ancient of the industries, languished in activity.

Sometimes I feel like saying, "the poor old cotton textile industry." But, just as this industry failed to share in pre-depression prosperity due to unsound practices, I am wondering if it is going to repeat its mistakes in the period of recovery now ahead. Happier days are here again. Business is better. The general outlook is the best since the beginning of the depression. Some people think the improvement is temporary. They say it is due to artificial conditions. They may be right. Even so, business in general is definitely moving ahead. Agricultural commodities are bringing relatively attractive prices. Unemployment, while still serious, is on the decrease. Some 5 million people have been put to work since the low point of 1933. Bank deposits are at an unprecedentedly high level. Excess bank reserves are at an all-time peak. Our gold holdings are the largest on record. The foundation has thus been laid for credit inflation on a vast scale.

Even the cotton textile industry has experienced considerable stimulation in the past two months. But in view of its many problems, and especially the major one of over capacity which I have just discussed, it would be a grave mistake to assume that the slight improvement now being experienced means that our industry is out of the woods. To the contrary, the cotton textile industry of the United States is facing a very critical period. The question is, have we the courage and intelligence to face the situation squarely and put our house in order before drifting back into the old practices of overproduction and unsound merchandising which hitherto have all but wrecked the industry. Let it be remembered that however desirable it may be to bring about much needed improvements in our present unsound methods of merchandising and distribution, that nothing really effective can be accomplished along these lines until the industry brings about some semblance of balance between production and consumption. After all, this is the real meat of our trouble.

Having attempted to emphasize the problem of overcapacity, I now wish briefly to discuss a few of the cotton textile industry's other major problems.

I shall first mention the processing tax. This is an intolerable burden under which our industry cannot long survive. After all, call the tax what you will, it is really a glorified sales tax amounting to probably 12 to 15 per cent. In theory this tax is supposed to be passed on to the ultimate consumer. However, the industry has never been able to pass it on in full and in the past year, many mills have been forced to absorb the tax in entirety. It is for this reason that I say the industry cannot long stand up under such a load. Happily, the chances are that this tax will be declared unconstitutional by the Supreme Court.

If not, it is imperative that some other way be found to lift the burden from the backs of a tottering industry.

Next in importance to the problems of overcapacity and the processing tax, is the serious situation brought about by the loss of our export trade and the ever-increasing imports of goods of foreign make—principally from Japan —which are upsetting the equilibrium of our domestic markets. The industry has frequently brought the seriousness of this situation to the attention of the Washington authorities, and it is hoped that some plan or plans can be developed that will afford the industry at least a measure of relief in both directions.

To illustrate the seriousness of the loss of our export trade, I need only point out that since 1929 it is estimated that at least 15,000 cotton mill employees have lost their jobs because of the rapid decline in the volume of this business. This has complicated the domestic situation not only in respect to employment but has greatly added to the difficulty of controlling the tremendous overcapacity to which I have previously referred.

At the recent session of Congress, the Agricultural Adjustment Act was amended to provide for the payment of benefits, as allocated by the Secretary of Agriculture, to encourage exportation of agricultural commodities *and products thereof*. In passing these amendments, it was clearly the intent of the Congress to extend these benefits to cotton goods in order to stimulate our sub-normal export trade. In furtherance of this, the American Textile Export Association recently submitted a plan to the Secretary of Agriculture providing for benefit payments of 7 cents per pound on the net cotton content of all export products of cotton. This plan to be administered in the same manner as present draw-back regulations on processing taxes through the utilization of Government machinery already set up. The amount asked for is fifteen million dollars, a comparatively trivial sum. Please bear in mind that I use the word trivial in a relative and not in a facetious way, because the amount is trivial when compared to the vast sums the Government is spending in its recovery program. The matter is now under consideration by the Department of Agriculture. If the plan is accepted, it is believed it will not only enable the industry to regain the export business lost in established markets in the past five or six years, but will also serve to assist the industry in developing new markets. It is most earnestly to be hoped that the Secretary of Agriculture will carry out the intent of the Congress as expressed in the A.A.A. amendments by allotting the fifteen million dollars in accordance with the plan submitted by the Committee.

Returning briefly to the question of Japanese imports: Dr. Claudius T. Murchison, retiring Director of the Bureau of Foreign and Domestic Commerce and recently elected President of the Cotton-Textile Institute, summed up the situation very well when he said:

"The great evil of the cotton textile industry in the United States is the uncertainty over Japanese imports. We know what they are but don't know what they will be tomorrow.

"Everything hinges now on negotiations between the State Department and Japanese representatives. An effort is being made to induce the Japanese to agree to a reduced quota for the American market.

"Such an agreement, in which Japan is limiting her textile sales in the Philippines to forty-five million square yards annually, was the first step. The next concerns curtailment of sales to American importers. A slash of 20 per cent below imports of this year would be highly valuable."

In connection with Dr. Murchison's statement, it might be well to call attention to the fact that reports to the Commerce Department showed cotton textile sales to the United States in the first nine months of this year reached 37,976,002 square yards. This is a jump of nearly 400 per cent over the 1933 imports and more than 600 per cent above those of 1931. It more than doubles cotton imports from Japan last year.

I might go on and mention many of the other problems of the cotton textile industry but time will not permit and most of them are minor compared to the ones I have already discussed.

Before bringing this discussion to a close, I cannot resist the temptation to again refer to the failure of some people in our industry to profit by past mistakes. Since the Code passed out of existence, a relatively few mills have resorted to third shift operations, while a few of those formerly operating on two shifts of 40 hours each, have increased their operations to two shifts of 48 to 50 hours each. A comparatively few small mills have reduced wages and resorted to other forms of chiseling. By and large, however, only a small minority of mills have departed from Code hours and wages. Even so, it is idle to assume that this movement will not spread unless some effective means is found to arrest it. This is why I advocate the setting up of some form of self-government in the industry subject to the approval and limited supervision of the Federal Trade Commission. Certainly no sound argument can be advanced for third shift operations. On the other hand, any number of sound arguments can be advanced against the practice. Indeed, if the industry should set out deliberately to commit suicide, the swiftest and surest way would be to resort to third shift operations on a wide front. One only has to look at recent developments in the rayon weaving industry to realize how quickly utter demoralization can be brought about by third shift operations.

To view the matter from a purely common-sense standpoint, it is stupid for anyone to engage in profitless third shift operations when he knows, under anything like normal conditions, he can operate at a profit on a second shift basis, of course, having due regard for seasonal

variations. Then some consideration ought to be given the welfare of one's customers who are always unmercifully punished through the pursuit of unsound practices by mills supplying their requirements.

Unfortunately, there are also a few weak mills in the industry which are being operated apparently for the sole purpose of giving jobs to the management. Mills of this type are persistent price cutters, especially during periods of quiet markets, in order to provide money to meet their payrolls, etc. Some way must be found to deal with this situation, although it does seem as if the stockholders would take a hand and stop the unnecessary dissipation of their assets.

My friends, never before has the cotton textile industry been operated at a higher state of efficiency than at present. Never before has it turned out such a wide diversity of goods of attractive styles or of such a high standard of quality. It can point with real pride to its accomplishments along these lines. But this makes it all the more tragic that the industry is being operated without a profit. Surely the time is not far off when the industry will become more profit-minded. This means that some volume must be sacrificed for profit. It means that enlightened cooperation must be substituted for so-called rugged individualism.

It is hoped and believed that Dr. Murchison, the new President of the Institute, will soon present to the industry some comprehensive plan looking to bringing about that state of stability which is so much to be desired and which is so urgently needed to enable the industry to settle down on an even keel.

Dr. Murchison is a sound economist. For many years he has made a profound study of the problems of our industry. Moreover, he possesses those splendid qualities of leadership which admirably fit him for the tremendous tasks ahead. I am confident, if the industry will accept and follow his leadership, that all will be well. If not, I would not like to predict what may happen. I can only express the hope that when future historians record the activities of the great American industries of the present generation, that they will not have to single out the textile industry as the only one operated on a profitless basis due to the lack of vision and sound judgment of those entrusted with its management.

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Processing of Thrown Silk*

By G. W. SEARELL†

SILK throwing is the term applied to the several operations by which the raw silk thread is converted into yarn for the knitting or weaving trade. Both raw and thrown silk are bought and sold on specifications called Raw Silk Rules, which were devised by the Silk Association of America. These rules govern transactions between buyers and sellers in the United States of America and cover contracts, deliveries, weights, variation of size, seriplane inspection, and terms of sale.

Because of the hygroscopic qualities of raw silk and the uneven moisture conditions of the shipping points in the Orient, all raw silk is purchased on "conditioned weight" which is the absolute dry weight plus 11%. Thrown silk is sold on a "conditioned clean fiber" weight plus a regain of 11%. The United States Testing Company is the official conditioning house of the American Silk Association.

The term "clearance" is of vital importance to the buyer, manufacturer, and seller of thrown silk. Clearance means the difference between the invoice weight of raw silk received and the weight of thrown silk delivered. It is sometimes erroneously believed to be the difference between the conditioned weight received and the thrown weight delivered and this interpretation has brought about very large clearances, some as high as 8% and 9% over the invoice weight. The excess clearance has brought an added task and expense to the throwster and the dyer, since the throwster must use more soaking material and the dyer consumes more time in stripping, and often the stylist of the fabric, receives a gross disappointment. High clearances mean an excess boil-off and when this yarn is woven the space which should have been occupied by silk is filled up by soaking material. A high boil-off also means short yardage. Some very interesting work was done with yarns of various boil-offs by Irving Lewin of Duplan Silk Corporation and was published a few years ago. This table showed that a crepe yarn having the correct conditioned weight and a 25% boil-off gave the best yardage and best finish. A high boil-off on hosiery tram means a lesser number of dozens produced.

* Presented at meeting, Piedmont Section, Feb. 8, 1936.
† Jacques Wolf & Co.

Confidence in the throwster to return a legitimate amount of thrown silk with a 25% boil-off and a constant yardage would certainly prove a boom to the silk industry in general.

Soluble silk oils give a much better resultant yarn than raw oils emulsified by soap, because the former penetrate deeper, lubricate, and soften. There has been developed recently an oil which requires only a small quantity to give a 25% boil-off, and a legitimate clearance; it has proven very successful on six and eight thread 20-22 denier yarns, and it leaves the silk immediately when it comes in contact with the boil-off bath, aiding that operation by acting as a wetting-out agent.

On account of the unequal importance of the different clearness defects in the manufacturing and finishing processes and in their effect upon the quality of the finished goods, a set of inspection rules must be carefully followed by silk inspectors who are trained in that particular field.

The sizes of Japan raw silk used in the weaving trade and hosiery are 13 to 15 denier or an average of 14 deniers and 20 to 22 deniers or an average of 21 deniers. The yards per pound of a one-denier silk is 4,464,528 and by dividing this figure by the average denier size any yardage can be determined.

The foregoing gives some idea about the sale and purchase of the "Queen of Textiles" and shows how specialized that business is.

The throwing proper results in crepe, tram, grenadine or organzine twist. Crepe is thrown silk having 20 to 100 turns per inch, more or less for use in making crepes such as georgettes. Tram is a number of strands of raw silk, soaked, doubled and twisted into a single thread. Organzine is a kind of thrown silk twisted like a rope with strands to increase its strength.

GRENADINE

All hosiery previous to 1930 was made from tram which consisted of two or more ends of pure silk twisted from one turn per inch to eight turns per inch. A vogue of dull luster produced by wearing hosiery inside out invaded the hosiery field during the summer of 1929, and during the spring of 1930 hosiery with permanent dullness fabricated in the hose attracted considerable attention.

You will perhaps remember the Young Patent of the Westcott Hosiery Company of Dalton, Georgia, which described a knitted fabric in which the dullness feature was inherent in thread construction. This so-called grenadine twist as stated in the patent was made by giving each single end of silk a twist in one direction of 32 to 48 turns per inch. These ends were then all brought together and twisted 28 to 44 turns per inch in the opposite direction. Thus to make a four thread 36 to 32 grenadine yarn each of four ends was twisted separately 36 turns left then four are brought together and twisted 32 turns right.

Because of the added spinning operations the manufacture of this yarn was very expensive and it accentuated raw silk imperfections instead of eliminating them as was thought the case would be, and therefore was abandoned.

This dull effect is now arrived at by chemical means with very little expense.

The various processes of hosiery yarn are:

1. Soaking
2. Conditioning
3. Winding
4. First Time Spinning
5. Second Time Spinning
6. Setting of Twist
7. Redrawing
8. Coning

To my mind the most important process is soaking. The raw silk as received in bales from the Orient is dry and brittle. To facilitate the various throwing operations and improve the quality of the ultimate finished fabric it is necessary to soften and lubricate the fibers and the outer coating of gum or sericin. Emulsions of sulfonated oils which are sometimes blended with raw animal and vegetable fats as well as mineral oils are commonly used to accomplish the softening. During the last year a considerable amount of research work has been carried on for the purpose of determining the basic principles in regard to the soaking process and its effect upon the finished fabrics. The soluble oils used as a base for these soaking oils must be from pure non-drying animal or vegetable fats and sulfonation must be controlled absolutely to avoid dry yarns, oxidation and rancidity. The blended oil must be so balanced that the throwster gets maximum efficiency of take-up and money value, which in turn has a direct bearing on the thrown clearance. In order to get permanent softness and lubrication these oils must penetrate the fiber interstices and not just coat the outside surface of the gum.

The soaking operation consists of immersing the skeins in a bath of soluble oil and soft water at a temperature of 85-95° F. for twelve hours. This method is called tub soaking. Several ingenious machines are also in use, which do the soaking in from one-half to two hours, thereby decreasing the inventory investment in the soaking department considerably. After soaking the skeins are removed from the tub with care and hydro-extracted; then they are sent to the winding department.

Conditioning or seasoning to allow the soaked skeins to dry out partially is the next process. This process requires three to four hours before placing on the swift in order to avoid stretched yarn.

Winding is the process of transferring the soaked, conditioned silk from skein to bobbin or spool. It usually takes about four hours to wind a skein of Japan silk on to a bobbin. The tension on the swift must be carefully predetermined to avoid stretched silk.

It is a good practice to make seriplane panels of wind-

ing bobbins occasionally to check with the raw stock inspection in order to note the condition and catch any faults in the winding department.

First time spinning is really a doubling process where a small amount of twist is put into the several ends as they are drawn into one single continuous thread. The number of ends drawn into one gives the number of the thread, such as six-thread means six bobbins were drawn into one thread. The spindle speed of this operation varies from 4,000 to 6,500 according to the weight of endage, whether four-thread or 12-thread.

Second time spinning is the operation in which the finished number of turns per inch are put in. The bobbins from the first time operation are placed on the supply spindles and spun upward to a much slower speed than the supply which varies from 9,500 to 12,000 r.p.m.

The full take-up bobbins from this latter spinning are now placed in a steam chamber where the yarn is set or made lifeless on the bobbin. Next to soaking, the steaming is very important since the time, temperature, moisture, and position of the bobbins play a part which will mean success or failure of the yarn.

After the bobbins of twist-set silk have dried sufficiently, they are redrawn through cleaners to take out waste and bunches and at the same time knotted with a weaver's knot to insure a continuous running yarn for the next operation.

The final operation previous to shipping is coning, where the yarn is placed on a package, usually a paper cone, suitable for knitting.

DISCUSSION

Mr. Searell: If there are any questions on the subject, which is very wide, I will be glad to try and answer them. My purpose in making the paper short was so you could ask a lot of questions.

Mr. Eddy: We are having these meetings for discussion and we want to try to bring out your problems or help you in some you have, so we want you to feel free to start an argument.

Mr. Grady Miller: What do you mean by 25 per cent boil-off?

Mr. Searell: That is more or less a crepe boil-off. That means the amount of gum and soaking or soluble oil on the yarn, so when you start off with 100 lbs. you have 75 per cent left.

Mr. Miller: Is that woven into crepe?

Mr. Searell: That is the finished product. It is ready for the dyehouse or weighting. It is a mixture of gum and soaking material. That is your total loss of 25 per cent.

Mr. Searell: The reason I brought that out, a lot of manufacturers are kidding themselves because when they send 100 lbs. they receive back 115 and if they had 110 they would be getting the outside figure. If they go to work and overload it with soap and oil, then the designer of hosiery or piece goods does not get what he wants.

There is around 18 per cent gum in raw silk, and soaking material makes the difference between 18 and 25. Some of these direct thrown yarns run as high as 30 per cent. Personally, I would not want to put it on, for while you might get fairly good running yarn, you do not get the number of dozen per pound in the finish you ought to. Instead of putting in 10 or 12 per cent of the boil-off material, you have to put in 15 or 20 per cent to get the material to knit well.

Mr. Eddy: If there are no other questions to be asked at the present time, we will thank Mr. Searell for his time and trouble in presenting this paper to us.

Mr. Searell: If anybody thinks up anything, I will try and answer it afterwards.

CALENDAR OF COMING EVENTS

Meeting, New York Section, Chemists' Club, New York City, May 22, 1936. Speaker: Dr. Feibelmann, Aktivin Corp., Inventor of "Aktivin"; Subject "Hydrosulfite and Vat".

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Council Meeting, Boston, Massachusetts, June 12, 1936, 10 A. M.; Research Committee meets at 2 P. M.

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Summer Meeting and Outing, Piedmont Section, June 27, 1936, Ocean Forest Hotel, Myrtle Beach, S. C.; reservations through Mason Alexander, manager.

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Annual Meeting, Providence, R. I., December 4 and 5, 1936.

The Majesty of Cotton*

By ALBERT O'HARE†

TO GIVE a discourse on raw cotton is a difficult task indeed, even for one who may be fairly well versed on the subject. There is a wealth of material from which one can draw, and the subject contains many phases, specialties within themselves. I have tried to prepare this paper in the most simple form, not too academic or technical, and with the minimum amount of statistics, at the same time endeavoring to make the subject comprehensive and interesting.

Cotton is the universal servant of mankind. It has always been an important fiber insofar as clothing the peoples of the world is concerned, although great inroads have been made by the substitution of rayon and silk. But cotton has such manifold uses that its products have been extensively utilized for industrial purposes which have offset the reduced consumption in clothing. Experiments are now being made on cotton roads and have proven successful. In fact, arrangements are under way to construct a runaway at the Newark airport reinforced with cotton cloth and when completed it will be the first of its kind in the world. It is estimated that approximately 15,000 sq. yards of specially made cotton cloth will be used in this undertaking. To indicate its possibilities of conversion, cotton may be spun into a yarn so coarse that one pound of it would measure only a few hundred yards, or so fine that a pound of it would extend 150 miles. It can be woven into a felt a quarter of an inch thick, or into a delicate fabric as sheer and filmy as gossamer. Nearly a 1,000 known uses of cotton and its products have been listed. In the United States the normal annual consumption of cotton per capita is about 27 lbs. The greatest commercial crop of the United States is cotton. This statement does not take into consideration the by-products of cotton, such as cottonseed, cottonseed oil, etc. It is the chief and often almost the only source of income to a large portion of the farmers in the Southern States. The price of cotton has ranged from $1.90 a pound during the Civil War to as low as 5c a pound in 1932. The average price for the past hundred years has been between 10c and 20c, excepting during the World War and the period immediately following when prices were as high as 45c a pound.

*Presented at meeting, Philadelphia Section, November 22, 1935.
†Statistician, Geo. H. McFadden & Bro.

In this discourse I will confine myself to the American cotton crop and will refer to foreign growth cotton for purposes of comparison only. But before so doing, I would like to relate to you the origin and a brief history of cotton, so often referred to as "white gold."

The earliest records point to the growth and production of cotton in India. In the year 800 B.C. we have the earliest authentic mention of cotton, where it is compared with silk and hemp as that of which was made the sacred thread of the Brahman.

From India cotton was carried to China, more or less as an ornamental plant, at some unknown date, but it was not grown as a fiber crop until about the 13th Century. Cotton was also introduced into Japan from India about the year A.D. 781. Later records show cotton in a number of other countries of the Eastern Hemisphere, but it is thought by many that it was taken originally from India.

In the Western Hemisphere cotton has been grown from the dateless past. Cotton cloths have been found on Peruvian mummies of a very ancient date. Columbus, in 1492, found the inhabitants of the West Indies growing cotton. In 1519, Cortez found the people of Mexico growing cotton and producing cotton fabrics, samples of which were included in the treasures sent back to Charles V of Spain. Likewise, in 1519 Magellan found cotton growing in Brazil, and in 1522 Pizarro found it growing in Peru.

In a word, everywhere between the parallels of 40 degrees north and 40 degrees south latitude, with the exception of the extensive region of the United States now known as the cotton belt, cotton, in its wild or cultivated state, was known and used at the date of the settlement of America.

The beginning of the culture of cotton in the United States occurred about 175 years before the industry became at all important. The first effort to produce cotton in the United States was probably made at Jamestown, Va. around 1609. Its cultivation spread slowly, and during the Revolutionary War it was raised for army use in the counties of Cape May, New Jersey, and Sussex, Delaware, and it continued to be raised, though only in small quantities for family use. It was also grown for domestic needs in Pennsylvania. At the convention at Annapolis in 1796 James Madison expressed the convic-

tion "that from the experience already had from the garden practice in Talbot County, Md., and the circumstances of the same kind abounding in Virginia, there was no reason to doubt that the United States would one day become a great cotton producing country." What a prophecy!

Cotton was not much of a commercial crop in the early days due to the great difficulty in separating the lint from the seed. The work was done by hand and it would take one person nearly two years to separate the seed from the lint to make one bale of cotton. (A bale of cotton as referred to in this talk is about 500 lbs.)

The greatest evolution in the production of cotton came with the invention of the cotton gin in 1783.

This invention opened the way for large scale production. For example, exports of cotton in 1793 amounted to about 975 bales while today the normal exports run between 7 and 8 million bales yearly. The first cotton mill erected in the United States was built at Beverly, Mass. in 1787, and this was soon followed by others. By 1799 the mills in this country consumed approximately 35,000 bales yearly. Today the average consumption of cotton in the United States runs between 5 and 6 million bales annually.

At present about 54 countries in the world have gone in for cotton growing on some scale, in some instances producing as little as a hundred bales in a season.

We are now prepared to discuss the growing of the American cotton crop.

The American cotton belt is composed of 16 States, in which there are 810 counties. This belt represents about one-fourth of the area of the United States and one-fifth of the country's population. Normally between 40 to 42 million acres are planted each season to cotton.

The planting of cotton usually begins the early part of March and is completed about the end of May. The successive stages of growing cotton are planting, bedding and chopping, the latter meaning cutting out with a hoe the surplus plants. The farmer cultivates the crop, keeping down the weeds and grass until the plant has grown to such a size that these will do little harm. Of course, there is fertilizing and spraying, etc. against the ravages of insects.

The principal stages in the development of the cotton plant are, successively, the stand, the square, the bloom, and the open boll. The term "stand" means the little stalk with two small leaves which the plant forms as it emerges from the ground. The term "square" means the formation of three triangular-shaped leaflets, known as bracts, and the flower-bud proper. The "bloom" is the flower of the plant; it is commonly white, pale yellow, or cream-colored on the day when it opens, turns red or pink the next day, and then having turned purple, falls to the ground on the third day, leaving the tiny boll. A field of cotton in bloom is surpassed by no flower garden and on the great plains of Texas and Oklahoma where cotton is planted as far as the eye can see, you can imagine what a wonderful sight it must be when cotton is blooming. The "boll" is the pod in which the cotton lint grows, attached to seeds; the young boll is green and tender, but as it develops it becomes hard and tough. Finally it splits open, and the ripe cotton is exposed. A large number of squares and bolls, estimated at 40% to 60% on an average, are normally "shed" by the plant; i.e., they drop off and fall to the ground, and hence do not reach maturity.

Cotton requires six months of warm weather including four to five months of uniformly high temperatures. Where conditions are normal the highest average yields are made in sections with over 200 days free from frost. Rainfall, of course, is essential. An ideal season for cotton production is a warm spring with frequent rains of a light nature, followed by a medium moist summer. The rains should be preferably of the thunderstorm type, and at night. The fall season should be cool and dry. The maximum stalk growth should be made by the first of August. Upon the weather and insects depend the yield.

There are said to be about 465 species of insects which feed upon the cotton plant. Among this number there are only a very few which are of much importance. The total annual loss caused by these insects amounts to many hundreds of thousands of bales. Some of those which are considered the minor insects may do considerable damage during some years, and in particular localities. The insect which receives the most publicity and is most entitled to it is the boll weevil. This pest immigrated from Mexico across the Rio Grande in 1892, and gradually spread over the belt, finally reaching the Atlantic Seaboard about 1917. Many hundreds of thousands of dollars have been spent to eradicate the weevil. It is estimated that the progeny within a season of one pair of over-wintering weevil is about 3,000,000. Other major important insects are the cotton bollworm, the pink bollworm, the cotton worm or caterpillar, the red spider, cutworms, leafworms, and plant lice. Therefore, you can immediately visualize that with unfavorable weather or excessive insect damage or both, an acreage that would under normal conditions produce 15,000,000 bales of cotton might grow only 10,000,000 bales. What an effect this would have on the cotton world and its price.

In consequence of the importance of knowing the progress of the cotton crop and anticipating its ultimate yield, the Government issues daily, weekly, and monthly reports during the growing and harvesting season. Private firms issue weekly or semi-monthly crop reports for the benefit of their clients. All these reports the trade follows with intense interest. The crop reporting system of the U. S. Department of Agriculture has been in existence for nearly 70 years.

The gathering, or the harvesting, of the seed cotton

after the bolls are open is known as picking. It is the most expensive operation in the production of cotton. One man can plant and cultivate 20 to 30 acres of cotton, but it takes from 4 to 5 good pickers to gather the average crop from the same acreage. Picking may be done in two ways, either by machinery or by hand. As yet no satisfactory mechanical picker has been produced. Picking by hand is done principally by negroes and during the picking season negroes of all ages and of both sexes may be seen in the fields. An average of 175 to 225 pounds of seed cotton can be picked in a day. Incidentally, it takes about 1500 lbs. of seed cotton to make 500 lbs. lint.

All cotton has to be ginned to be commercially valuable. There are approximately 15,550 gins in this country of which about 13,500 are active in any given season. The ginner puts the lint cotton in the form of bales which are known as flat bales. As cotton is shipped to larger towns or to domestic mills it is compressed into smaller sized bales, known as standard bales, and when destined for foreign countries it is again pressed into still smaller sized bales. This is known as high density and is done to save space in shipping.

We are now to the point where the cotton is ready to go to market.

But before cotton goes to market it is necessary to determine its quality. The classification of cotton is one of the most important phases of the cotton business. Each bale is sampled, that is a small quantity of cotton, about ¼ of a pound, is taken from each side of the bale, the poorest side being used to determine the quality of the bale. Quality is determined by color, the amount of foreign matter, the length and strength of the staple. The U. S. Department of Agriculture has established 37 different grades of cotton and staple lengths are graduated by 1/32 of an inch. The details of classing cotton are impossible to describe, and knowledge of it can be gained best by observation. A basis grade has long been established in the trade, which is known as Middling grade ⅞ inch staple. Premiums are paid for cotton classing better than this basis and discounts are allowed on cotton classing under. When it is remembered that the average farmer produces only 5 to 7 bales, the concentrating and segregating the crop into usuable lots, ranging from 25 to 100 bales, is a stupendous undertaking. Furthermore, in normal times a crop moves off the farms in a period of from 3 to 4 months, although the distribution of the crop to the world's consuming centers involves the 12 months of the year.

Buyers representing all kinds of interest are located in every section of the cotton belt during harvesting season. They buy from farmers who bring one or two bales to town, or from small country store merchants, or from factors who sell the cotton for the farmer on a commission basis. There are also larger markets known as spot markets, such as Galveston, Houston, Memphis. In fact, there are ten officially recognized spot markets in the South, although there are others where the volume of trading is just as large as in the officially recognized ones. There are also spot markets in New York, Liverpool, Havre, Bremen and Osaka; but these perform in a different manner than those in the South.

A cotton merchant will buy cotton during the harvesting season against commitments he has already made, or buy for stock to sell at a later date. As he buys the cotton he classes it, segregating it into even running lots, that is lots of one grade and staple. The marketing of the crop or delivering the commodity to the door of the mill where it is to be consumed in the manufacture of goods is a complicated procedure and has gradually evolved into the present system of marketing through a period of over 150 years.

I will not go into this phase except in a general manner. Mills often buy cotton right in the belt through their own representatives, but a large portion of the crop is marketed through merchants or shippers and exporters. Competition in this branch of the business is very keen.

A cotton shipper agrees to sell to a mill 100 bales of cotton of a certain grade and staple length, to be shipped at some future date. The price may be 10c a pound at the time the sale is made. The shipper may or may not have the cotton on hand. It all depends on whether he thinks he can buy cheaper now or later on. If he did not buy until the time of shipment and the price rose to 14c this would apparently result in a terrific loss. Shippers would be ruined and the merchandising of cotton would become the greatest gamble in the world. We read in a market report in a daily paper that the price of cotton has fallen one-quarter of a cent a pound, and to most of us this seems of slight importance. But one-quarter of a cent a pound is $1.25 per bale, and hence, if there are 8,000,000 bales in the world this means that the market value of the world stock has dropped $10,000,000. Rather a sizeable shrinkage for one day!

But this is where the cotton exchanges enter as a price insurance market. When the shipper sold the 100 bales to the mill he bought one cotton future contract. This is known as hedging. Let me illustrate the process in its simplest form. Assume that the merchant did not have the cotton at the time he agreed to sell the mill, and assume that the selling price was 10c a pound. At the time of the sale he goes to the cotton exchange and buys one future contract at the market price which is 10c. When the time comes to deliver the cotton the prevailing market price is 14c a lb. Apparently the shipper has lost 4c on the cotton he sold to the mill. But the value of his long future contract is 14c, therefore, he sells his contract taking the 4c profit applying it against the 4c loss on the actual cotton. But, you may ask, where does the merchant profit? The buying of a future contract on a cot-

ton exchange is the same as buying 100 bales of cotton. In other words, if you would go out today and buy one March future contract that would mean that when March came around you would receive 100 bales of cotton. But these 100 bales would not all be of one grade and staple, but possibly as many as 23 different grades. You, as a mill, require a specific grade and staple; therefore you buy from a shipper who concentrates and segregates the cotton.

For this service you pay a few points more over the future contract price. This is known as the basis in which is the merchants' profit.

Cotton financing is another phase and calls into use every form of modern instruments of credit. It involves foreign exchange and with a few foreign countries it is now necessary to barter cotton due to the absence of dollar exchange in those countries. This is another complicated function that has been added to the already involved system of marketing cotton.

On top of all this we have the Governmental intervention. In recent years the Government has taken a paternalistic attitude toward the farmer, although for many years the Department of Agriculture has lent aid in various forms, such as improved standards, selection of seed, crop rotation, crop progress reports, and many Congresses have endeavored to pass legislation curbing abuses on the exchanges, finally resulting in the enactment of the Cotton Futures Act in 1914. Government intervention as far as affecting the growing of cotton in the United States has been sponsored by both major parties. Today we have the widely publicized Agricultural Adjustment Act. This in itself would also consume the best part of an evening, even to discuss superficially.

As a barometer of trade, Alston H. Garside, Economist of the New York Cotton Exchange, in his recent book "Cotton Goes to Market" so aptly says of cotton:

"It is with good reason, that businessmen, economists, bankers, and public leaders, in this country and abroad, watch closely the progress of successive cotton crops and the fluctuations of cotton prices, particularly of American cotton. The cotton trade is a major artery in the circulatory system of the world business. In the United States and other important cotton-growing countries, the size of the crop and the price of the staple affect the volume of demand for countless commodities—farm implements and shoes, furniture and radios, lumber and steel—for they determine the buying power of millions of growers and the activity of gins, compresses, railroads, warehouses, shipping lines, banks, and insurance companies. Foreign exchange rates may rise or fall on the payments entailed by cotton exports and cotton imports. Fluctuations in cotton prices affect the cost of living all over the world. The movement of cotton reflects the level of world buying power. From many standpoints, therefore, cotton is a barometer of world trade."

This gives you an idea of the magnitude of this commodity. I have only skimmed the surface, trying to give you the highlights and some interesting facts.

Before closing permit me to give you a few statistical facts.

The United States is the largest cotton-growing country in the world. India is the second largest growing country, followed by China, Russia, Egypt, Brazil. The largest cotton-consuming country is the United States, followed by Japan and Great Britain respectively. On an average 25,000,000 bales of cotton are grown yearly and up to the last few years over 50% of this was grown in the United States. Consumption ranges between 22,000,000 and 26,000,000 bales yearly.

It has been genuine pleasure and an honor to be permitted to address you. Thank you.

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CORRECTION

Re "A Test for Mercerization"

In the article entitled "A Test for Mercerization in the Presence of Dyes" by Sydney M. Edelstein appearing in the April 6th issue the paragraph numbered 6 on page P189 should read as follows:

"Activity numbers of mercerized and unmercerized yarns dyed with a variety of dyes were determined. The unmercerized samples showed an activity number of 100 regardless of the presence or kind of dyes on the sample."

MARCH MEETING, RHODE ISLAND SECTION

Friday, March 27, 1936 at the Providence Engineering Building.

THE meeting was called to order at approximately 8:15 P. M. by Chairman Masson. Donald H. Powers of Rohm & Haas Co. presented a paper on "Resin Treated Textiles" in which he illustrated the various effects which may be obtained by applying synthetic resins to cloth. This paper was followed by a three reel motion picture supplied by the Bausch & Lomb Optical Co. entitled "The Eyes of Science" which illustrated the processing of the optical parts of the instruments manufactured by the Bausch & Lomb Optical Co. A few descriptive remarks concerning the film were added by Harry Wayne of the same company.

The meeting adjourned with a rising vote of thanks to the speakers.

Attendance 80.

Respectfully submitted,

RAYMOND A. PINGREE, *Secretary.*

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Knitting Arts Exhibition

THE Knitting Arts Exhibition which closed on April 24th certainly can be classed as one of the better trade expositions. Everyone who attended the five-day show, many of whom have been going to this exposition for the past 25 years, agreed that the 1936 show took first rank for convenience of layout and attractiveness of appearance. A large majority of those who exhibited apparently felt that results from this exhibition will be far better than any in recent years.

Wet processors of knit goods who attended were well repaid as there were many exhibits of special interest to them. These special exhibits were brought to the attention of our readers from time to time before the show opened and we shall do this again next year in the hopes that there will be an ever-increasing number of visitors from the wet processing branch of the knit goods trade who will annually go to Philadelphia at the time of the Knitting Arts Exhibition.

Drying

AN important conference on textile drying has been called for this coming Wednesday, May 6th, at the Hotel Pennsylvania in New York by the Research Council of the U. S. Institute for Textile Research. Officially the subject is listed as "Drying That Will Preserve the Natural Properties of Textile Fibers and Products, and That Will Eliminate the Defects and Losses in Dyeing, Finishing and Other Processing That Are Due to Improper Drying" and the purpose is stated as being "To learn through open discussion whether there is anything connected with these problems which needs scientific research for its solution or correction, and that is likely to produce worthwhile results."

The term "drying" in itself seems very simple but there are so many variables that one encounters in textile drying that there will be plenty of topics for discussion at the conference. While the subject of drying has been a tentative subject for research for some time it was the disclosure by the warp sizing study of the U. S. Institute of the wide variation in temperatures that are being used by different mills for the drying of sized warps that caused the Research Council to place the subject on the active list. In addition to this phase of drying the other variables such as time, moisture content, regain of fibers, relative humidity, volume of circulated air as well as the economical side of drying—drying production and costs—all serve to further complicate the simple term "drying" when applied to textiles. It is stated that while there are no statistics available showing the annual losses in dollars and cents due to inefficient textile drying, no statistics are needed to prove that the losses due to dyeing and finishing troubles, in yarn and fabric strength, and in the desired "hand" or feel of the finished fabrics, for which it is responsible are tremendous in number.

All members of the industry, including manufacturers of drying machinery and control apparatus, have been invited to attend; something worthwhile to the textile industry should develop and whether it is adequately appreciated by them or not the textile manufacturers will be the ones to benefit.

Textile Education

ON another page of this issue a report of the meeting of the heads of the various textile schools in Atlanta, Ga., on April 16th and 17th is published. Under the auspices of the Textile Foundation this meeting represented the fourth regular semi-annual gathering of the group. The work being done by the Textile Foundation in this respect should prove of considerable value in time to come. At present they are concerned chiefly with the development and production of a new set of textile textbooks to be used in conjunction with the presentation of the various courses at the textile schools. While there have been many excellent textbooks written which have been found valuable for certain subjects incidental to a textile education there are other subjects for which no adequate textbooks are available. It is to be hoped that a complete and suitable set of books will result from the deliberations and discussions of this group.

Textile Printing Colorists

AT a meeting held last June a New York-New Jersey-Pennsylvania Section of the National Association of Textile Printing Colorists was formed. A similar section was formed for the New England territory. A meeting of the New Jersey group is scheduled for May 16th to be held at the Elks Club in Paterson, New Jersey, starting at 2 o'clock. I. F. Chambers of the Dyestuffs Division of E. I. duPont deNemours & Co., Inc., will address the gathering on the subject of "Some Technical Aspects of Vat Color Printing."

This association has been progressing quite rapidly in the past few months and lately has had some very able speakers address them on subjects related to their particular field. We wish this association many more successful meetings in the future and believe that members will be amply repaid for their attendance.

Cotton-Warp Sizing

(Continued from page 236)

1. Most rapid growth: dextrine and wheat, rice, and cassava flours.
2. Intermediate group: wheat and corn starches, gum tragacanth, and soluble starches.
3. Slow growth: tapioca flour, sago, and potato starch; the latter treated with alkali showed only a very slight growth.

Detection of Mildew.—Treatment with lactophenol and cotton blue renders the infecting spore and mycelium visible. Two solutions are used:

(a) Lactophenol solution: phenol 10 gm., lactic acid 10 cc., glycerine 20 cc., and distilled water 10 cc.

(b) Cotton blue, 1 gm. in 100 cc. of water.

Spot fabric with lactophenol, warm for two minutes, immerse for a short time in warm cotton blue solution and wash with water; spot again with lactophenol, warm, wash with same, and observe under the microscope.

ANTI-MILDEW AGENTS

Properties.—It is to be noted that some of the substances used as anti-mildew agents may cause the sizing to degenerate and liquefy. Antiseptics for use in cotton sizing should possess the following properties: (1) must not volatilize during boiling of the size, or drying of the yarn; (2) must be soluble enough to assure an even distribution throughout the size-mixture; (3) must be unaffected by heat, metallic surfaces, or ingredients in the size; (4) must not have an odor or color, nor develop them during processing; (5) must have no action on cotton; (6) must not affect dyeing or finishing; and (7) should not cost more than zinc chloride.

Zinc Chloride.—Zinc chloride has long been the standard preservative for use in size, but it is a makeshift at best, because of its weight and undesirability in some fabrics. It is still, however, the standard of comparison although not a sure preventative. It combines with soaps to form insoluble zinc soaps and is therefore harmful to softening. It may also migrate in large bales due to its deliquescent nature. It is stated that the tendering action of zinc chloride on cotton is not so much due to the formation of free hydrochloric acid as it is to the formation of a hydrated cellulose zinc oxide compound. It was demonstrated that if cotton were treated with zinc chloride solution and steamed, the fibers became swollen and translucent, and in many respects resembled mercerized cotton. Zinc chloride, however, is a good antiseptic for heavily sized material. By careful experiments it has been found that 8 per cent of solid zinc chloride to the starch is sufficient to preserve it from mildew under ordinary conditions.

Salicylanilide.—Salicylanilide or Shirlan is considered the most satisfactory of all the substances now available for use on cotton materials. Among the advantages which it possesses may be noted its lack of volatility, its inertness to heat and metals, its absence of odor and color, and the fact that it does not react with cotton and a large number of such dyes as are usually applied to this fiber. Salicylanilide is sparingly soluble in water—100 grams of water dissolves about 0.005 gram at 25° C, and only 0.08 gram at 100° C. Nevertheless, in a concentration of as little as 0.005 per cent it shows good antiseptic properties. The sodium salt crystallizes with four molecules of water and is much more soluble—100 grams of water dissolves 31.7 grams of the crystals. Either the sodium salt of the compound is used or it is dissolved in a solution of caustic soda or ammonia. The compound may also be applied in the form of a suspension in water. For size mixings, 0.06 per cent of Shirlan is recommended on the weight of the dry size. It is claimed that Shirlan is a good fungicide but not a good bactericide.

Salicylic Acid.—In the absence of chlorides, salicylic acid gives excellent results; 6 ounces to 100 pounds of starch is recommended. It is, however, not very effective in alkaline mixtures.

Other Anti-Mildew Agents.—It is claimed that sodium fluosilicate is a good bactericide and a fairly good fungicide. It is very soluble, free from odor, and effective in small concentrations—about 1½ ounces to 12 quarts of size are recommended. Copper sulfate is said to be 15 to 20 times as effective as zinc chloride. Its blue color produces a desirable whitening effect, but it may turn black, due to its conversion to copper oxide on coming in contact with alkali. Thymol is considered an efficient antiseptic, but is rather expensive. Phenol and cresylic acid are powerful antiseptics but undesirable on account of odor and volatility. It takes about 10 ounces of these antiseptics to 100 pounds of starch to preserve it properly. Boric acid is said to be 3 to 4 times as efficient as zinc chloride. It is sparingly soluble in cold water but readily soluble in hot water. As an anti mildew, 2 per cent of boric acid to the weight of the starch is recommended.

Experiments With Anti-Mildew Agents.—Antiseptics were tested upon culture-media which consisted of sizing materials in agar jelly. The moulds used were types which have been found on textile materials. In the following table are listed the results, including the phenol coefficients of the antiseptics (i. e., the toxicity of the agent compared with that of pure carbolic acid or phenol on an equal weight-basis):

Substance	Toxic Concentration in Starch-Agar %	Phenol Coefficient	Remarks
Zinc chloride	0.8	0.16	Considerable specific differences
Salicylanilide (Shirlan)	0.1	....	.....
Boric Acid	3.0	....	Considerable specific differences
Sodium Fluoride	0.8	0.16	.....
Sodium Silico-Fluoride	0.15 or less	0.87	Liable to attack copper rollers
Thallium Carbonate	0.02	6.5	.....
Copper Sulfate	0.10	....	Possible color
Formaldehyde	0.05	2.6	Volatile, irritating vapor
Phenol	0.13	1.0	Odor
P-Nitrophenol	0.007	7.6	Yellow except in acid solutions
Tribromophenol	0.01	13.0	Odor
Thymol	0.05	2.6	Expensive
Salicylic Acid	0.05	2.6	Should not be neutralized
Napthalene	0.24	0.54	Odor
Napthalene sulfonic acids and Sodium Salts	0.25	....	.....
Thiocarbamide	0.80	0.16	.....

Quantity Required.—The following table shows the amounts of various antiseptics which have been recommended for pure sizing, based on the weight of the starch:

Zinc chloride (solid)	6%
Sodium silico-fluoride	2%
Boric acid	2%
Cresylic acid	0.5%
Copper sulfate	0.3%
Salicylic acid	0.3%
Phenol or carbolic acid	0.5%

(To be concluded)

—— ♦ ♦ ——

The Relation Between Chemical Constitution and Color*

By Dr. Moses L. Crossley†

WHILE not new, the subject of chemical constitution and color is a very vital one for all of us who are interested in the practical chemistry of the manufacture of dyes and other substances for the production of color. The average research director in industry is concerned more with the fundamental problems underlying his work than the academic men generally believe. The stage has been passed for just taking the information from the literature and using it. Now-a-days new additional fundamental data are sought in the industrial laboratory and every effort is made to correlate such data with existing published records of research.

To workers with organic compounds to produce color, the most important problem is that of structure. It is particularly desirable to determine what definite structure corresponds to a particular color. While exact information in this field is still in its elementary stages, some important generalizations have been reached. These conclusions are based largely on the changes in color produced by placing substituents in various positions on aromatic nuclei such as naphthalene.

In the dye where aniline is coupled with the naphthalene derivative, known in the trade as Schaeffer's salt, an orange color is obtained. By shifting the sulfonic acid group in this compound from position six to position seven the color is lightened. Again, by shifting the sulfonic acid group from position six to position three of the naphthalene nucleus, there is a deepening or bathochromic effect.

In the case of the aniline part of the molecule, introducing a nitro group, for example, into its nucleus produces a change in the color of the dye. In general, the meta substituents produce light colors and whatever their effects, the otho and para positions are practically identical. Much effort has been devoted to seeking a possible connection between the stability of this dye and the location of groups in the ortho, meta, and para positions of the aniline part of the molecule. Thus far the results have been disappointing. Introducing a methyl group in these same positions in the aniline part of the molecule produces effects similar to those obtained by the nitro group. Chlorine is similar but it produces a less marked change in the color. However, it does give brighter tones and faster colors.

The position of the azo group on the napthalene nucleus has a marked influence. In general, when in the alpha position the colors are all darker than when it is in the beta position.

There are ways of changing the colors of a dye without introducing a substituent into its nucleus. For example, the general effects on color of treating with chromium salts is well-known. Treatment with iron salts produce still other effects.

In spite of the fact that such a slight modification in the nucleus as changing the position of a substituent may produce a marked change in color, it is possible to build up very large and complex nuclei which still have light color. Dyes with large molecules may possess light yellow or golden orange tones and be very fast into the bargain.

Sometimes the dye chemist appears to think of colors only as they are applied to fabrics and sometimes the organic chemist thinks only of dyes in terms of the structure of their molecules. Even when taken together these two views form an incomplete picture for colors are used more widely than simply in fabrics and more than a knowledge of structure is necessary in duplicating shades. Such new materials as modern plastics are produced in a variety of colors and the chemist is bound to find that the capacity of a dye to color materials is profoundly influenced by many other factors not mentioned in this account.

*A Brief Summary of the Address before the Rhode Island Section of the Am. Chemical Society, February 13, 1936. Reprinted from the "Nucleus".

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Technical Notes from Foreign Sources

Azo Pigment Dyeing Upon the Fiber

"Z."—TIBA 11, 349 (1933).—A description and discussion of a new method—rather a new refinement of an old method—of dyeing developed colors upon woven goods, as worked out by the "I.G.". The following will give a good idea of what is involved.

Ordinarily, to produce azo colors upon the fiber, the goods are padded with a solution of a substantive passive component, such as the arylamides of 2-hydroxy-3-naphthoic acid, of acetacetic acid, of 2-hydroxy-anthracene-3-carbonic acid, of an o-hydroxy-carbonic acid of the benzene series, etc., the color being then developed by passage of the padded goods through a solution of a suitable diazotized amine. After the development, the goods are exposed to the air, and passed through a warm bath of dilute carbonate, and finally rinsed and soaped.

Now, in more than one case, the coupling takes place rather slowly and incompletely under the conditions normally prevailing; above all, if we employ components of a relatively high molecular weight. When one employs a diazo-salt which couples slowly, then, during the further course of the process, especially during the soaping, it may be observed that a portion of the diazo-salt has not coupled, or is separating from the fabric in the solid form, or as a solid in a derivative form.

The diazo-salts are more or less unstable, except at rather low temperatures. At the same time, the passive or second components, for example, the alkali salts of the arylamides of 2-hydroxy-3-naphthoic acid, are not always stable under the conditions prevailing during coupling, and in part decompose easily, with formation of undesirable by-products.

This inconvenience is especially annoying when we are dealing with reserve printing; the unaltered diazo-salt, which separates out in substance in the soap bath, reacts with the second component present in the reserve, and either muddies or actually dyes these areas.

The I. G. Farbenindustrie has found that dyeings cleaner and better in every way can be obtained, as well as a more complete coupling, by subjecting the goods to a treatment at an elevated temperature, immediately after the goods have left the diazo or developing bath. In spite of the greater instability, at the higher temperature, of the substances undergoing coupling, especially the diazo-salt, the coupling as a whole takes place more rapidly than the decomposition of the components, and dyeings are obtained which are the result of more complete coupling than is ever attainable by the more usual method—a result which could not have been foreseen.

The goods are simply padded as usual, and passed through the diazo-bath, and then treated at once at a temperature considerably higher than that of the work-room. In general, the acceleration of the coupling increases as the temperature rises; but temperatures of at least 50° C., preferably of 100°-115° C., have proved to be most suitable. To avoid decomposition of the components, however, it is best to impregnate the goods with both components at the usual low temperature. The treatment in the heat may, for example, be carried out conveniently by passing the goods over steam-heated cylinders. In this way, the goods are rapidly brought to a temperature of about 100° C., and the coupling takes only a few seconds for completion. Or, the goods may be passed through a heating chamber, the heat being applied by heated flat plates at such distance apart that the goods just pass by without actually touching the plates; any number of such heating elements may be employed, and of any desired shape or build or size.

The process as thus carried out permits the production of dyeings which in most cases are deeper, oftentimes 30-40 per cent stronger in tone than those obtained by the older method; and there is run no risk of the loosely-attached particles of components or loosely-fixed azo pigment in substance soiling the goods in any part, ground or reserve.

An essential advantage of the method lies in the fact that satisfactory results may be attained by use of mixtures of different diazo-salts, even of those which ordinarily cannot be satisfactorily used, on account of either their too great speed in coupling or their insufficient solubility and consequently low rate of coupling. The process can also be used advantageously for printing reserves, for a considerable quantity of organic acids may be employed in the diazo-salt bath without the coupling being influenced unfavorably.

If heated cylinders be the means used for carrying out the process, no new apparatus will be needed; the ordinary steam-heated drying-cans, or similar equipment, are perfectly suitable. If steaming be the method employed, the goods are simply passed over conducting rolls through the steamer, and perforated pipes, from which the steam plays uniformly over the breadth of the goods, are placed at suitable positions and in suitable numbers in the steamer. As to applying the heat by passage between heated plates, the plates, as above mentioned, need be only far enough apart from each other to allow unhindered passage of the goods; and may be of any shape, size, or number desired, and heated by either live steam or electrically; the goods may pass between the plates, just touching each face, or just touching one plate and passing just free of the other, or passing just free of each. This point brings up another; when reserves are printed upon the goods, the heating device can be so arranged that, with cylinders, the goods shall touch the latter only upon the unprinted face, and with heated plates either pass entirely free, or touch only the heated plate at the back of the goods—

thus any part of the reserve paste is prevented from becoming detached, and causing fouling.

Seven very full and detailed procedures are added, as examples.

Uviol-Printing With 2-Benzoyl-pyridine

H. Freytag and A. Mueller—Monats. f. Textil-Ind. 48, 239 (1933).—Earlier papers by the senior author and other co-workers have been noted in these columns, under the general heading of the action of Uviol-light upon pyridine, under the name of "photo-pyridine".

The present paper is an account of the action of Uviol radiation upon 2-benzoyl-pyridine, and the photographic printing of negatives upon fabrics sensitized by this substance. The prints are of a gray or grayish-green or greenish-gray. The method is in course of further study, and at present is only in the purely tentative stage. It can hardly be stated, with any justification, whether it will ultimately prove technically useful, or remain an interesting curiosity. More unlikely possibilities have ultimately proved valuable when developed.

Practical Questions in Bleaching

J. Ernst—Monats. f. Textil-Ind. 48, 267 (1933).—A comment upon three topics: the bleaching of natural silk and wool, with sodium peroxide, bleaching without kiering, and remarks upon bleaching in vacuum.

Under the first topic, that of bleaching natural silk or wool with sodium peroxide, the point is made that the process, now quite generally practiced, is perfectly safe in skilled hands; the silk simply has to be carefully boiled off, and the wool carefully washed, before bleaching; and that it does no harm if, after this cleansing, a little soap or soda remains in the goods. The bleaching bath is made up by dissolving 2-3 kilos of magnesium sulfate in 100 liters of water, then, after solution, adding slowly 600-800 grams of sodium peroxide, with stirring, and finally adding 300-400 cc. of conc. sulfuric acid, again slowly and with stirring. The bleaching is carried out over a range of from 35° to 50°-75° C. at the end. The bath must be neutral, otherwise the goods come out spotty and with the luster damaged; and for wool it is best to keep not over 50° C.

As to bleaching without kiering, the second topic, the author remarks that "well boiled out is half bleached", but that any kind of kiering produces an undesirable hardness in the goods. Boiling out with water alone, in the case of delicate goods, proved, even before the war, to be the solution of this difficulty. As to the bleaching, sodium hypochlorite, prepared as "Eau de Javelle" (i.e., bleaching-powder paste treated with soda-ash solution, followed by addition of considerable Glauber salt, diluting, letting settle, and decanting) has been found to produce a good bleach without hardening the fiber, as would be the case with hypochlorite prepared by chlorination of caustic liquor, as ordinarily done.

The last topic treated, bleaching in vacuo, is a description of the process as carried out practically; quite a full description, in a short space.

Vat Dyestuffs (Perylene Series)

German Patent No. 495,658 (*April* 10, 1930).—*Felice Bensa, Genoa, Italy.*—The procedure here protected consists in the conversion of various chlor- and polychlor-perylenes into the corresponding quinones, by heating them with fuming sulfuric acid at temperatures of from 130° to 180° C., the oleum acting, as so often, as an oxidizing and not sulfonating agent.

For example, 2 parts of dodekachlor-perylene and 100-120 parts of oleum of about 25 per cent (this seems like an alarmingly large amount of oleum—can so much be really necessary?) are heated together for 3½ hours at 150°-160° C. Both chlorine and hydrochloric acid are evolved. The color of the mixture passes through dark green to a blue, finally to a deep blue; on dilution with ice-water, a dark violet solid with greenish reflex is precipitated. It is purified by recrystallization from hot nitrobenzene, in which it is easily soluble; in alcohol, carbon disulfide, carbon tetrachloride, acetone, and glacial acetic acid it is either insoluble or practically so; and difficultly soluble in boiling benzene, toluene, or xylene. It does not fuse at 360° C.

The product vats to a deep blood-red solution, in which cotton is dyed the same color; on oxidation, the dyeing becomes olive-green, very dark if deeply dyed. By after-treatment with certain metallic salts, such as alum or chrome alum, the color becomes red to violet—which makes one suspect the presence of hydroxyl groups as well as quinone groups.

Indigoid Dyestuffs

German Patent No. 494,948 (*April* 4, 1930).—*Gesells. f. Chem. Ind. in Basel.*—The common starting-point of the syntheses of this procedure is 6-chlor-7-methyl-3-oxythionaphthene, or its thio-derivative or anils; which are condensed with otherwise substituted oxythio-naphthenes or thionaphthene-quinones or their anils, or with other compounds suitable for the synthesis of indigoid dyestuffs.

For example, 5-7-dibrom-isatine is suspended in chlorbenzene, and heated with phosphorus pentachloride, thus producing 5-7-dibrom-isatine chloride. The solution of this is then run into a solution of 6-chlor-7-methyl-3-oxythionaphthene in chlorbenzene, with stirring. The new dyestuff precipitates at once, and is filtered off, washed, and dried.

This particular product is a violet powder, soluble in conc. sulfuric acid with a green color, and giving a golden-yellow vat with hydrosulfite, whose dyeings after oxidation are a violet. Other examples are also given. The products may be further halogenated to increase their fastness-properties, but, as they are, possess very good fastness in general, and are of handsome tones.

New Products—Trade Notes

● SUEDING MACHINE

Featured at the booth of R. L. Sjostrom & Co. at the Knitting Arts Exhibition was a new type of finishing machine known as the Seide Sueding Machine which is said to produce a fine, dense nap or pile on fabrics with continuous filament fibers such as rayon and also, if desired, on pure silk, wool, cotton or linen. It is stated that with this machine cloth can be napped or sueded in a great variety of ways. The cloth is passed between high speed cutting rollers and a pneumatic bed with adjustable pressure. The rollers are also adjustable individually or as a series. Complete details are given in a circular which is available upon request.

● HERCULES MOVES

The New York offices of the Hercules Powder Co. are now located at 22 East 40th Street near Madison Avenue.

● SOUTHERN CHEMICAL CORP.

Announcement has been made of the formation of a new company to be known as the Southern Chemical Corp. which is headed by John L. Crist, formerly southern sales manager of the Calco Chemical Co. Arthur J. Buchanan is vice-president and Leland G. Atkins, formerly superintendent of Mathieson Alkali Works at Saltville, Va., is superintendent. Present plans call for the erection of six units for manufacturing operations and another building to house laboratories and offices. The new company will deal with the manufacture and distribution of dyestuffs and chemicals for the textile trade. For the time being offices are being maintained at 822 West Morehead Street, Charlotte, N. C.

● QUARTERLY PRICE LIST

The quarterly price list of the R & H Chemicals Dept., E. I. duPont de Nemours & Co., Inc., for April 1936 has recently been issued. Copies are available upon request.

● NATIONAL RELEASE

National Aniline & Chemical Co., Inc., announces release of the following bulletin. Copies are available upon request.

National Milling Yellow 2 G C W—a further addition to the National line of neutral dyeing colors for wool, pure and tin-weighted silk. It is said to possess very good solubility and to draw very well in a neutral bath. It is especially recommended by the manufacturers for use in the dyeing of hosiery or other materials having white acetate effects, being suitable for this purpose in either a neutral or an acid bath. It is also said to be useful for the printing of pure and tin-weighted silk, and for white discharge effects on these fibers. It is said to possess excellent fastness to sea water, washing and perspiration and good fastness to light, fulling and rubbing. Bulletin No. 200.

● M. I. T. SUMMER COURSES

A five weeks course on colloid chemistry will be given this summer at Massachusetts Institute of Technology beginning June 16, 1936 under the direction of Dr. E. A. Hauser. This course will consist of lectures, round table discussions and laboratory investigations and is offered to men actively engaged in industry or in research organizations. In case there are a sufficient number of persons interested in rubber technology, a special course will be given relating to this subject. Correspondence regarding this course should be sent to Prof. E. A. Hauser, M. I. T., Cambridge, Mass.

Another summer program on applied physics will feature spectroscopy and color and their applications. The conferences and courses of this program are fully described in a circular which may be obtained from the Registrar of the Institute.

● GENERAL RELEASES

General Dyestuff Corp. announces release of the following circulars, copies of which are available upon request.

Celliton Fast Yellow 5 R—a new dyestuff for acetate, which produces a fine golden yellow shade said to possess excellent light fastness. Circular I. G. 1155.

Diazo Brilliant Orange G A Extra—a dyestuff which produces a bright yellow orange when diazotized and developed with beta naphtol. The shade is said to possess very good fastness to washing and excellent dischargeability. Circular G-146.

Indanthren Turquoise Blue G K Paste—a new homogeneous indanthren dyestuff for the dyeing of rayon and cotton, producing a clear blue shade said to be of excellent fastness to light and to possess good fastness to washing and chlorine. It is a cold dyeing color and can be used successfully in combination with all those vat dyestuffs which have to be dyed at low temperature. Circular I. G. 1151.

Supramine Blue R A—a new acid dyestuff which when dyed from a Glauber's salt—acetic acid bath and exhausted with sulfuric acid levels well and produces reddish navy blues said to be of good fastness to washing, water, perspiration and light. The fastness to steaming and hot pressing is said to be very good, and the fastness to crocking good. It is also said to exhaust well from a neutral bath and may be used as a shading color to cover the wool in union dyeing. It is said to have good affinity for silk. Circular G-115.

● DUPONT EXHIBIT

A total of 61,996 people attended the Fashion Review at the Du Pont Exhibit in Atlantic City, which was held from April 6th to 13th inclusive. The review was presented twice daily, with an additional evening session on Saturday.

"Kerrylin"—a new cotton fabric dyed with Du Pont Vat Dyes—fashions this fitted coat worn over a plain black linen frock. Vivid green carried out in gloves, matching handbag and plastic buttons of the frock, smartly accent the ensemble. Note the smart wide brimmed hat of "Cellophane" that completes the costume. This model was shown as part of the fashion review at the Du Pont Exhibit at Atlantic City, April 6-13.

Sixty-six costumes were shown with accompanying hats, shoes, gloves, and handbags, illustrating the application of Du Pont products to present-day fashion. Rayon and "Acele" yarns were exhibited in high-style costumes for all occasions. "Cellophane" appeared in glamorous frocks, hats, and evening wraps. Du Pont Dyes were represented by fast-color linens and cottons and "Pyralin" was featured in Scuffless Heels on new Spring shoes, in washable handbags, and in slide fasteners on costumes, gloves, and purses. Other costumes showed the efficacy of "R & H" bleaches and chemicals used in the finishing of textiles.

● SELF SUFFICIENCY IN DYES

Progress made by the world's leading manufacturing nations in their efforts to

attain self sufficiency insofar as their dye requirements are concerned has been one of the outstanding industrial developments of the past decade, according to C. C. Concannon, Chief of the Commerce Department's Chemical Division.

Germany, the United States, Great Britain, Japan, Soviet Russia, France, Switzerland, Italy and Poland, are now the world's leading producers of coal-tar dyes, and while there still exists a considerable trade in certain types of dyes between these countries, all of them have attained a high degree of self-sufficiency, he stated.

All of the countries mentioned except Germany and Switzerland, have so far concentrated largely upon producing for the domestic market, but most of them have developed an export trade as well, particularly with China and British India and other countries which are still either partially or wholly dependent upon foreign sources for their dye requirements, according to Mr. Concannon.

Official statistics regarding Germany's dye output are not available but estimates placed it at approximately 76,000 metric tons during 1934 compared with 66,000 tons during the preceding year and 75,000 metric tons in 1929. A substantial part of the German output, approximately 50 per cent, is exported, the bulk going to Oriental markets, chiefly China and India. Exports from Germany during the first three-quarters of 1935 were recorded at 23,484 metric tons compared with 24,230 tons during the corresponding period of 1934, according to a report from Frankfort-on-Main.

American dye manufacturers are now supplying our entire domestic requirement for such materials, with the exception of certain special items, and are gradually increasing their export business, statistics show. Total United States exports of coal-tar dyes, colors, stains, etc., were valued at $6,873,000 in 1935 against imports of such products, almost entirely from Germany and Switzerland, valued at $6,034,000, according to Mr. Concannon.

Great Britain, the third largest world dye producer, credited with producing around 24,000 metric tons in 1934, is also practically independent of foreign sources for its dye requirements, exporting more than it imports.

Switzerland, with its limited dye consuming industries, produces almost entirely for export, the 6,577 metric tons which were exported in 1935 representing around 95 per cent of the total domestic output, according to estimates. Half the dyes imported into the United States last year originated in Switzerland.

The Soviet dye industry has made rapid progress in recent years, the output in 1935 aggregating around 25,000 metric tons, according to a statement from the head of the industry. Except for special dyes, equipment for the manufacture of which the Soviet industry does not yet possess, the entire local demand is satisfied at home, and exports of finished dyes and intermediates are said to be increasing. Special equipment is now being installed and complete self-sufficiency is anticipated by the end of the current year.

The Japanese dyestuffs industry continued to make rapid progress in 1935, and at the end of the year was satisfying a very large part of the domestic demand. Japan's dye exports totalled 19,583,000 pounds during the year against imports of only 2,771,000 pounds, and such inroads were being made into nearby markets that German producers began negotiations with Japanese manufacturers regarding the sale of dyes in China, according to the Chemical Division.

● DYESTUFFS

The March 1936 issue of *Dyestuffs*, publication of the National Aniline & Chemical Co., has recently been distributed. Included in this issue are articles on the coloring of buttons, dyes for coloring paper (concluded), dyeing of knitted acetate silk fabrics, removal of spots from hosiery (continued), and an article on dry cleaning which is concerned with Naccolene F, a new reagent for use in dry cleaning with petroleum solvent. There are also articles on the processing of azoic colors on raw cotton and on screen printing. Copies of *Dyestuffs* are available upon request.

● MEETING, TEXTILE SCHOOL HEADS

The heads of the textile schools of the country met in Atlanta, Ga., on April 16 and 17, this representing the fourth regular semi-annual meeting of this group. These meetings are held under the auspices of the Textile Foundation, in connection with the Foundation's study of textile educational methods and needs. While in Atlanta, the school heads were the guests of the A. French Textile School of Georgia School of Technology, Atlanta, and its director, C. A. Jones.

In the business meeting, the school heads considered the furtherance of their plans, in conjunction with the Foundation, for the development and production of a new set of textile textbooks. Work on this program is progressing, and it is hoped to have some of the new texts ready for the fall 1936 term.

Frederick M. Feiker, who conducted a survey of textile education for the Foundation two years ago, and Edward T. Pickard, secretary of the Foundation, were in charge of the meeting. Franklin W. Hobbs, chairman of the Board of the Textile Foundation, was also present, taking his usual active part in the work and deliberations of the meeting. Luther H. Hodges, production manager in charge of the manufacturing plants of Marshall Field & Co., Spray, N. C., discussed textile education from the point of view of mill management. at the school men's session on Thursday evening, April 17, and Cherry L. Emerson, president of Robert & Co., Inc., Atlanta, Ga., also spoke at this session.

A. H. Williams, professor of Business Administration, Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia, who is working with the Foundation and the School heads in connection with plans to develop textile economics courses for use in the textile department, reported on the progress made to date in this connection, stating that two units of this text material will be available for use this fall.

At a dinner session held at the Atlanta Biltmore, Dr. M. L. Brittain, president of the Georgia School of Technology, met with the group, and extended to them a most cordial greeting from Georgia Tech.

William H. Dooley, Principal, Straubenmuller Textile High School, New York City, attended the meeting and gave a very interesting account of the work being done at his institution.

After the session in Atlanta, the textile school men were the guests of Fuller E. Callaway, Jr., at LaGrange, Ga., visiting the industrial school and other units of the Callaway Mills, and also the Fairfax Plant of the West Point (Ga.) Manufacturing Co.

The session was concluded by visiting the textile department of the Alabama Polytechnic Institute, Auburn, Ala., of which E. W. Camp is director.

The deans and heads of the eleven textile schools attending the meeting were:

M. E. Heard, Director, Textile Dept., Texas Tech., Lubbock, Texas.

J. B. Bagley, Director, Textile Dept., Texas A & M, College Station, Texas.

E. W. Camp, Head, Textile Dept., A. P. I., Auburn, Ala.

H. H. Willis, Dean, Textile Dept., Clemson College, Clemson, S. C.

Charles H. Eames, President, Lowell Textile Inst., Lowell, Mass.

Henry W. Nichols, Principal, Bradford-Durfee Textile School, Fall River, Mass.

J. H. Handford, President, New Bedford Textile School, New Bedford, Mass.

W. D. Fales, Director, Providence School of Design, Providence, R. I.

Dr. E. W. France, Director, Philadelphia Textile School, Philadelphia, Penna.

Thomas Nelson, Dean, Textile Dept., N. C. State College, Raleigh, N. C.

C. A. Jones, Director, A. French Textile School, Georgia Tech, Atlanta, Ga.

● NEW OFFICERS, SOCIETY OF CHEMICAL INDUSTRY

The American Section of the Society of Chemical Industry announces the election

of the following officers to serve for the year ending June 1, 1937:

Chairman, James G. Vail.
Vice Chairman, Wallace P. Cohoe.
Hon. Secretary, Foster Dee Snell.
Hon. Treasurer, J. W. H. Randall.

Five new members were elected to the Executive Committee to take the place of retiring members. Those newly elected are Charles N. Frey, Robert J. McKay, A. A. Backus, L. S. Kohnstamm and S. P. Miller.

• LIQUID CAUSTIC SODA

The Mathieson Alkali Works announces publication of a new 72 page booklet entitled "Cutting Costs with Liquid Caustic Soda" which is intended for use by operating men, executives, buyers and chemists at every plant where caustic soda is used. This booklet should prove of interest to all of the above mentioned persons.

As one of the pioneers in the distribution of liquid caustic soda, Mathieson is particularly well equipped to discuss this comparatively new industrial commodity. Their new book presents a thorough-going study of the economics of the "solid caustic vs. liquid caustic" question and gives much useful information on the handling of liquid caustic soda. Comprehensive technical data on sampling and analysis methods as well as on the properties of caustic soda and its aqueous solutions adds greatly to the value of the book as a handy reference manual.

The book is divided into four parts, the purpose and contents of which are well described in the Foreword: "The material presented in this book is intended to serve a four-fold purpose. For the plant executive interested in a possible change from solid to liquid caustic soda, part I contains facts which may enable him to judge the benefits of such a change in his own plant.

"For the plant operating man, part II provides useful information on approved methods for the unloading, handling and storage of liquid caustic, including materials and types of construction best adapted to this service. The technical man will find in part III comprehensive data on the properties of caustic soda and its aqueous solutions, including many useful tables and graphs, some of which are presented in an entirely new and more convenient form. Part IV gives up-to-date information on the sampling and analysis of caustic liquors which should prove helpful to the laboratory man."

The data contained in the book, it is stated, "is based upon the wide experience of Mathieson chemists and engineers and upon information gathered from authoritative reference sources". Pictures and charts have been used profusely to illustrate equipment and to present useful data in graphic form. Undoubtedly, "Cutting Costs with Liquid Caustic Soda" will prove valuable in effecting economies in the use of caustic soda by both present and potential consumers of liquid caustic. Anyone interested in liquid caustic soda may obtain a copy of the book by writing to The Mathieson Alkali Works, on their business letterhead.

OPEN FORUM

Unanswered Questions

27—Is there any satisfactory method for detecting the presence of sulfur black on a dark blue dyed fabric when a small amount of sulfur black has been added to the sulfur blue to deepen the shade?—**P. B. M.**

33—I will appreciate advice and suggestions regarding the treatment of white cotton batting put up in wrapped loose rolls, sold to dry goods stores and others for "home-made-quilt" fillers.

The cotton is a high grade card waste, new, thoroughly clean and has the natural color tinge.

I would like to give it a slight or very mild bleach to whiten it a bit, and would like a process which is generally considered best and safest for cotton of this type and that will tender it the least.

Are there any gas bleach products for cotton on the market?

Have you any information as to the use of "Ozone Gas" for bleaching and is such a product being manufactured?

The bleaching needs to be economical and not necessarily perfect for this type of material.

We are further interested in the method of mechanically handling this material during the bleaching process.—**H. A. H.**

34—We are interested in obtaining what is known as a Mousseline de Soi permanent finish on chiffons and marquisettes.

The solution must be one that will not mark off and that can be applied either through a quetch or by immersion.—**B. P. D. W.**

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED—Experienced chemist and dyer on acetate rayon and silk is now available. Formerly connected with two of the largest organizations in the dyestuff and dyeing industry. Can furnish excellent references. Forty years of age, married, and willing to go anywhere. Box No. 880, American Dyestuff Reporter.

WANTED—Salesmen to handle dyestuffs as a sideline for well established house. Write full particulars. Box No. 899, American Dyestuff Reporter.

WANTED—Competent wool dyer for laboratory and demonstration purposes. Write Box No. 900, American Dyestuff Reporter.

WANTED—Textile chemist with mill and laboratory experience in cotton dyeing. Write Box No. 901, American Dyestuff Reporter.

POSITION WANTED—Executive position desired by chemist skilled in the manufacture of sulfonated oils and other specialties. Competent to handle salesmen, familiar with sales methods and modern dyeing and finishing procedures. Write Box No. 902, American Dyestuff Reporter.